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NEW YORK STATE BROKEN GRAVEL MACADAM H. O. ROAD UNDER CONSTRUCTION

This Was Left Unfinished During the Winter, Which Accounts for the Ruts Formed. Preparations Are Being Made for Applying the Hot Oil Top.

## NEW YORK STATE HIGHWAYS

How Fifty Million Dollars is Being Spent—Organization of the State Highway Commission—Problems and Methods of Maintenance—Types of Construction—Specifications—Details  
—Typical Construction Work

IN the State of New York there are approximately 80,000 miles of road, of which about 3,000 miles have been improved as State or county highways, 3,000 have been macadamized as town roads, 8,000 have been improved with gravel as town roads, 40,000 miles have been shaped to some extent, and 26,000 miles remain in their original condition. In 1905, by a constitutional amendment, \$50,000,000 of bonds were authorized for the purpose of constructing State and county highways. Beginning with the year 1906 the appropriations made annually have been, respectively, \$5,000,000, \$3,000,000, \$3,000,000, \$5,000,000, \$11,000,000 and \$8,000,000, making a total appropriation to date of \$35,000,000. In addition to this bills were passed by the last Legislature for so-called "expedited routes" amounting to \$13,955,000, leaving a balance unappropriated of \$1,045,000. At the present time there have been constructed approximately 2,940 miles of completed highways and 710

miles are under contract and most of them nearing completion. These contracts provide for the remaining unimproved portions of a highway from New York City to Buffalo via Albany, and for the larger part of the highway from New York north to the Canadian border at Rouse's Point. "This," says the State Highway Commission, "will place the State of New York in the front rank as regards continuous construction, the total mileage completed and the amount of money appropriated."

In constructing these roads they are divided into four classes: State highways, the entire cost of which is borne by the State; county highways, one-half of the cost of which is borne by the State; "expedited routes" (connecting the more important centers of population and industry in the State), the entire expense of which is borne by the State, and town highways, a part of the cost of which is borne by the State.

During 1911 about \$8,800,000 was spent by the various towns throughout the State in the repair and maintenance of the roads and bridges, of which amount about \$2,000,000 was contributed by the State and the remainder raised by taxation by the towns themselves. There are about 77,000 miles of town highways in the State, a considerable proportion of which have not yet been improved by either State or town. The amount donated by the State, as well as that raised by the town, is in the custody of the local town officials, but the work is constantly under the supervision of the State Highway Commission, and assistance and direction is given to the town officers by representatives of the commission to insure that the terms of the law be complied with in levying and collecting the money required. No money can be spent under agreements by the town boards



POORLY LOCATED ROAD IN WET WEATHER.

unless these are satisfactory to the commission, and the actual field work also is under the supervision of its representatives. Under this system the old haphazard work has been stopped and special attention is being paid to the construction of proper culverts, widening, grading where possible, and throwing up proper shoulders to retain the metalling. Town superintendents have been encouraged in the construction of reinforced concrete bridges with their own labor, using local materials as far as possible. In two counties of this State during the past year not a single contract has been let for a bridge of 30 foot span or under, and in very many counties the instances in which contracts for bridges under this span have been let are few. Not only reinforced deck bridges, but also arches of both concrete and stone masonry, of which any contractor might feel proud, have been erected by town superintendents in all parts of the State.

In carrying on this work of supervision the State is divided into ten districts, with an officer, known as a district supervisor, in charge of each. The supervisor keeps closely in touch with all of the town highway affairs in his own district. The law requires that meetings be held annually in each county for the instruction of town officials in their various duties and for discussion of general highway problems. These are well attended, not only by officials, but by many of the citizens, and their importance as an educating medium is recognized not only in the State, but by adjacent States, and the meetings are attended by many highway officials and citizens from such States. The total amount of town highway work done under the supervision of the bureau includes about 500 miles of gravel resurfacing, about 300 miles of macadam, in widths varying from 9 to 15 feet and finished depths of 6 to 10 inches, about 5,000 miles shaped and crowned, about 10,000 permanent culverts and 900 bridges.

#### MAINTENANCE.

There are at least 3,351 miles of State and county highways to be maintained by the commission, and about 200 miles of these now need resurfacing, which is the most serious condition at present confronting the Bureau of

Maintenance. "The longer the work is delayed, and the more it is attempted to give them a temporary relief the more costly will be the result. Not alone will it cost more in dollars, but the inconvenience to the traveling public, and consequently loss of time, in yearly closing these highways for what can be but temporary repair is as unbusinesslike as it is costly." Approximately 1,000 miles additional are in need of a light top course of fine stone or gravel and oil treatment, much of which work can be done by the regular patrol with the outfits owned by the State and under the supervision of the division superintendents of repair. About 50,000 feet of new guard rail is necessary and 200,000 feet or more needs repairing and painting. The latter work can be done by the patrolmen, but it is proposed to have all new guard rail built by contract and in as long stretches as possible.

During 1911 \$1,015,253 was spent for maintenance and repair, in which the following materials were used: Stone, 40,018 tons; gravel, 40,870 cubic yards; oil, 1,076,926 gallons; iron ore tailings, 1,674 tons. It is expected to use more than double these quantities during the present year, and an appropriation is asked for of \$2,919,959.

For the purpose of maintenance the State is divided into six divisions, each in charge of a superintendent of repairs, under whose direction the highway inspectors, foremen of laborers and patrolmen perform the duties assigned to them by the commission. These divisions are divided into 31 sections, each containing from one to five counties. (There are 57 counties in the State.) It is proposed to increase the number of sections, making each county a section by itself. This would add to the number of section inspectors, but would not increase the working force, and would, the commission believes, materially expedite the work of maintenance and repair.

Several towns of the State have applied the patrol system to the maintenance of the town highways with very excellent results, and where the system has been thoroughly tried it has been very clearly demonstrated that the same amount of money could not have been expended in any manner which would have yielded a larger return.

The problem of maintenance has been rendered additionally difficult by the fact that the improvement of the



COMPLETED ROAD, SHOWING SERVICEABILITY OF SHOULDERS.

highway system has called into existence a class of traffic which was never contemplated in the original scheme, namely, the use of traction engines in hauling heavily loaded cars and the use of motor trucks. Regular freight lines of motor trucks have sprung into existence between large towns and the combination of enormous weights on narrow tires, and rapid automobile pleasure vehicles has resulted in a rapid deterioration of surface, and, in many cases, of the foundation as well.

#### TYPES OF CONSTRUCTION.

In the summer of 1911 the highway work of the State was placed in charge of a commission different from the old, not only in the personnel but in the principle of its composition. The new commission consists of Superin-





SHAPING BANKS WITH STEAM SHOVEL.

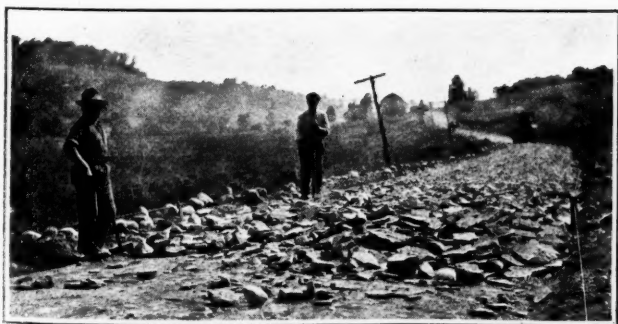
tendent of Public Works Duncan W. Peck, State Engineer and Surveyor John A. Benschel and Superintendent of Highways C. Gordon Reel, the latter being the only one who is appointed especially to this commission, the other two being ex officio members. The present commission is making some changes in the types of construction favored, probably the result of the experience of the past commission fully as much as of different ideas.

The type of construction formerly used, known as bituminous macadam, has not given results which would justify the increased cost in the opinion of the present commission. "This commission also believes that it is impossible to obtain satisfactory results in highway construction until more attention is given to sub-soil drainage, properly designed and constructed foundation, and a wearing course in which there is a more complete physical and chemical union of the units composing it—one which acts as a wearing course only, and not constructed so that its main function is to assist an improperly drained and poorly designed foundation.

"Having these factors in view it seems wise, wherever possible, to construct a foundation of concrete and to cover this with a thin wearing course composed of bituminous material and screenings or sand which is economical in first cost and easily and cheaply renewed. The foundation of a road so constructed is good for all time, and the wearing course serves the purpose of carrying all classes of traffic without rutting, raveling or raising a dust.

"While the concrete-bituminous type of highway will probably be most generally adopted, owing to local conditions, the supply of proper material, and the fact that the traffic on some of the outlying highways does not, as yet, warrant the adoption of this class of construction, other classes and types of construction will be used. The problem of mixing clay, or ordinary soil, with bituminous material seems to have been solved, and it is intended to thoroughly try out this class of construction, since in many localities it will furnish an economical substitute for materials which have to be imported at a high cost for freight and hauling. This commission believes that this latter factor will materially reduce the cost of construction.

"The cheaper forms of construction which have been adopted consist of a top bituminous treatment of gravel and hard-pan soils, and the placing of a bituminous wearing



PREPARING SUB-BASE.

surface on well-constructed water-bound macadam roads."

The commission also intends to give more study to each individual highway, believing that in this way excessive cost can be reduced and highways obtained which will better withstand traffic and the elements. In both State and city work it is too common a practice to adopt a standard type of construction, and to use this regardless of whether or not local traffic and soil conditions warrant its adoption. "Now the conditions of each highway are studied by the division engineer and his assistants and reported to headquarters. Then there is a general conference at which these conditions are thoroughly discussed and the type of construction assigned to each highway which most fully meets the requirements.

"So far as is practical, a five-year maintenance bond is to be required on all the best classes of construction. This will have a tendency not only to reduce the future maintenance cost, but will also cause more careful construction."

The ideas of the commission are probably well indicated by the contracts already let this year for more than 350 miles of highway construction. These contracts provide for 84.87 miles of what is known as "water bound macadam H.O."; 59.12 miles of "rocmac"; 53.95 miles of gravel with bituminous top; 43.16 miles of brick pavement; 32.86 miles of grouted bituminous macadam; 21 miles of concrete with bituminous top; 18.93 miles of what is known as "sub-

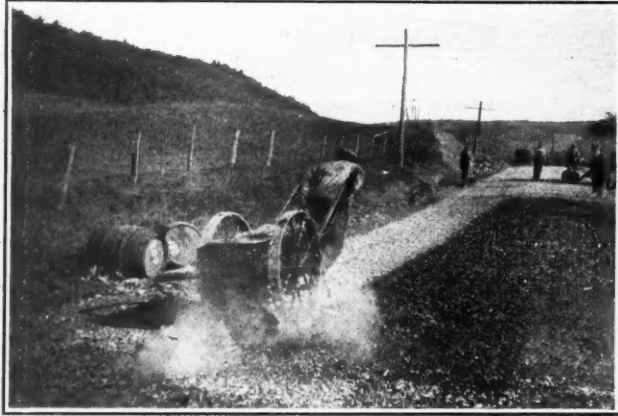


APPLYING HOT OIL.

base-bituminous"; 14.47 miles of California asphaltic concrete; 10.66 miles of Hassam grouted concrete with bituminous top; 7.59 miles of bitulithic pavement, and 6.97 miles of cementitious Hudson river gravel. The constructions provided for under these several titles may be briefly described as follows:

Sub-base—bituminous consists of a sub-base of stone or gravel to which is applied what is known as "bituminous material H. O." The bottom course is composed of large stone, none of which is more than 6 inches thick, nor more than 8 inches long, which is placed by hand and the larger interstices filled with No. 4 stone or No. 3 stone, and which is then rolled with a ten-ton roller until the stone ceases to creep. It is then covered with a light coating of screenings spread on dry, rolled and swept in; this being continued until no more screenings will go in dry, after which the road is saturated with water and rolled, more screenings being added if necessary and the general process kept up until a grout has been formed that fills all the voids and forms a wave before the wheels of the roller. Following this it is treated with the bituminous material. Gravel may be used in place of the bottom course of stone, no stone being used larger than 3½ inches. If necessary to consolidate the gravel, 5 per cent. of dry pulverized loam or clay is incorporated with it. Where it is thought desirable glutrin mixed one part to three of water is ap-

plied to the surface of the roadway by means of a sprinkler so regulated that not more than one-fourth gallon per sq. yd. is used at one application. Four applications are made, the first as soon as the roadway has thoroughly set, but not dried out, and the other three at intervals of several days, but with not more than three weeks intervening between the first and last application.



APPLYING ASPHALT BY HAND DRAWN DISTRIBUTOR.

The road is allowed to dry, and may be thrown open to traffic for a time, before the bituminous material is applied. Before placing this, it is swept until all the dust has been removed, the surface is sprinkled until the top course is clean, and it is then allowed to dry out (traffic being kept from it) after which the bituminous material is sprayed on the surface at a temperature of not more than 400 degrees F. nor less than 300 degrees; it being specified that the temperature of the air shall not be lower than 50 degrees. This is applied with a pressure sprinkler of such construction that the amount applied may be regulated and spread on the road in a thin uniform sheet. Immediately after the application of the oil,  $\frac{3}{4}$ -inch in depth of perfectly dry screenings, pebbles, or coarse, clean sand is spread over the surface and rolled in; following which the roadway is evenly covered with  $\frac{1}{4}$ -inch coat of the same material and thrown open to traffic.

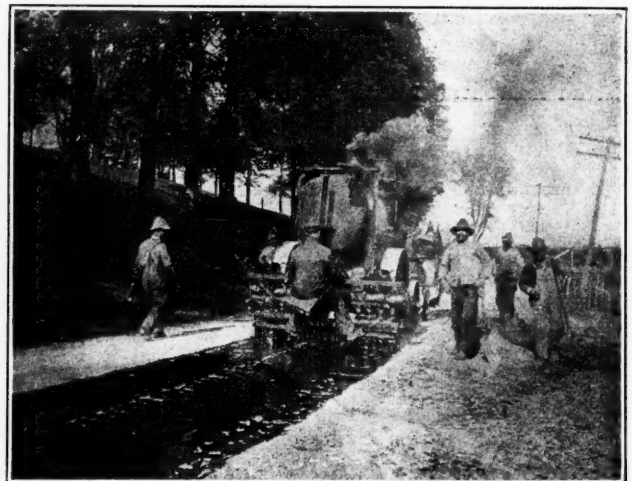
Water bound macadam H.O. rests upon a sub-base either of a bottom course of large stone similar to that just described (this being used where there is soft clay, silt, quicksand, or other unstable material) or the sub-base may be natural soil. On this is placed macadam in two courses, the bottom 6 inches thick and the top course 3 inches thick; a filler of clean, coarse sand, crusher dust and stone screenings being used in the bottom course, and coarse stone screenings for the top course. The stone for the bottom course consists of the run of the crusher up to 3-inch stone, the depth of the loose stone in this and all similar work being gauged by laying cubical blocks of wood on the sub-grade. This is then rolled until the stone ceases to creep and the filler is swept in dry with brooms and the rolling continued. The surface of the bottom course is swept clean before placing the top course. The top course consists of run of crusher from screenings to and including 2-inch stone. This is treated as was the bottom course, and after no more screenings will go in dry the road is saturated with water, the rolling being continued and more sweepings added until the grout of stone dust and water forms a wave before the roller. The road is then thrown open to travel and thoroughly sprinkled once a day in dry weather for thirty days; enough screenings being spread on top of the macadam to leave a wearing surface at least  $\frac{3}{8}$ -inch thick. Where the engineer desires, glutrin may be used as a binding material as described under "sub-base bituminous." After the road has been open to traffic for a while it is swept clean and bituminous material H.O. applied as described above.

Rocmac pavement is 5 inches thick when rolled in place

and is constructed in the following manner: Fifteen imperial gallons of Rocmac binding solution (a patented material) are added to one cubic yard of limestone crusher dust and thoroughly mixed. This is spread evenly on the sub-grade in a layer 12-3 inches thick. Broken stone consisting of equal proportions of Numbers 2 and 3 mixed is then spread on this mixture to such a depth that when rolled and consolidated it is 5 inches thick. If the stone is dry it is thoroughly dampened before spreading. The road is then rolled rapidly until the matrix appears on the surface, and from then on as slowly as possible. As the matrix rises through the stone it is brushed forward and diagonally from the sides of the road toward the center in order to prevent it from lying in patches. After the rolling is completed a thin coat of limestone dust is spread over the surface to absorb the excess solution and to form a cushion while the process of setting is going on.

Gravel with bituminous top is made by placing on the sub-grade screened gravel of three grades, that which has passed through  $\frac{1}{4}$ -inch,  $\frac{2}{4}$ -inch, and  $\frac{3}{2}$ -inch openings, the proportions of each as well as the thickness being determined by the engineer to fit the conditions. This is then rolled and covered with a light coat of screenings which are swept in and rolled, this being continued until no more screenings will go in dry, after which the road is covered with glutrin in the manner described above. It is then treated with bituminous material H.O. and screenings.

In constructing grouted bituminous macadam, after the sub-grade has been prepared a layer of broken stone con-



SPREADING HOT ASPHALT WITH DISTRIBUTING MACHINE.

sisting of crusher run up to 3-inch stone is spread and rolled several times before putting on the filler. The filler for this course is clean coarse sand or stone screenings supplemented by product of the crusher not otherwise used in the top or bottom courses. This is spread and rolled, and as the rolling proceeds additional sand is swept in dry with brooms and the rolling continued until the voids are completely filled. The top course of stone consists of run of crusher up to and including 2-inch stone, which is rolled with a grooved roller weighing not less than five tons until the stones cease to creep, after which  $1\frac{1}{4}$  gallons to the square yard of bituminous material A, heated to 400 degrees F. is spread evenly over the surface by the use of a mechanical sprinkler which sprays the material under pressure. Following this, sufficient screenings are added to fill the voids and cover the road thinly, and the rolling is continued with a five ton roller until the screenings are thoroughly rolled in. The loose screenings are then swept off with hand brooms and one-third gallon per square yard of bituminous material H.O. is spread over the surface in the same manner as before and immediately covered with  $\frac{3}{8}$ -inch of dry screenings and rerolled until an absolutely firm and smooth surface is obtained.



Concrete-bituminous top consists of concrete mixed with only such an amount of water that when the mass is rolled with a ten-ton roller the mortar will not be forced through the stone to the surface in any quantities, but enough to give it a slight appearance of moisture. The rolling is continued until the aggregate is thoroughly compacted, care being taken to remove the roller before the concrete begins to take its initial set. After this the concrete is not disturbed for twelve days, and after taking initial set is kept sprinkled for at least 48 hours. The proper surface is obtained by using timber templates, the concrete being struck off to the correct surface. After the concrete has become thoroughly dried any dust is swept off and bituminous material T heated to a temperature of approximately 250 degrees is sprayed on the concrete at the rate of one-fourth gallon per square yard and is immediately covered with a layer of screenings one-fourth-inch thick. These are then rolled with a 5-ton roller and as soon as possible after this, bituminous material H.O. is applied at the rate of  $\frac{1}{4}$ -gallon per square yard at a temperature of approximately 350 degrees, and is immediately covered with  $\frac{1}{4}$ -inch of screenings and thoroughly rolled. If screenings are not available sharp sand is used. In some cases the concrete is reinforced by the use of Hyrib metal constructed from 26 gauge steel, the ribs approximately  $7\frac{1}{2}$  inches from center to center and  $1\frac{1}{2}$  inches high; and with steel rods.

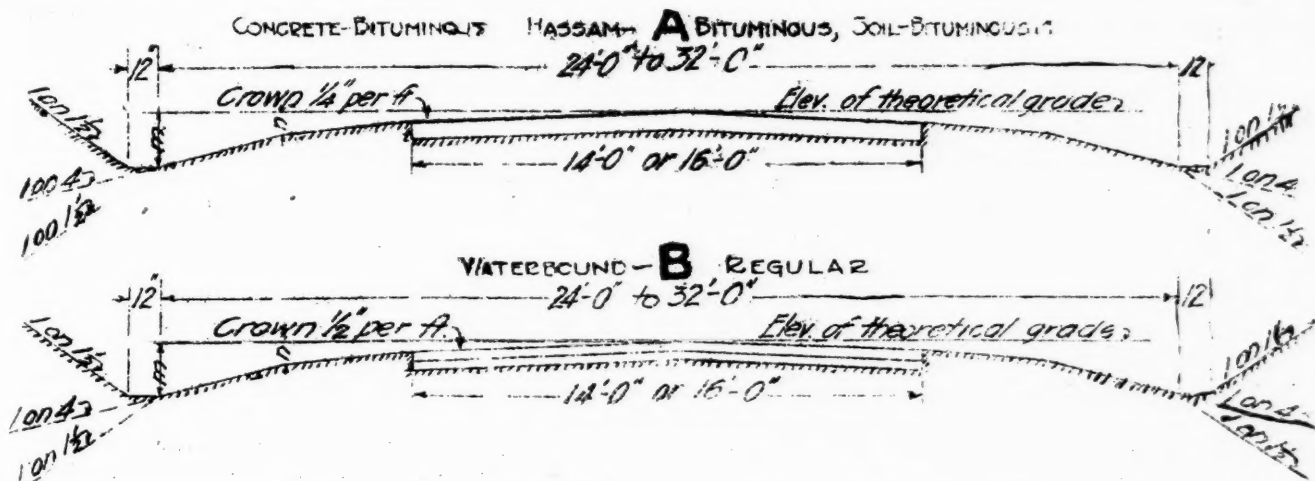
California asphaltic concrete is prepared by mixing together from 7 to 11 per cent. of California asphaltic cement; 5 to 11 per cent. of mineral aggregate passing 200 mesh screen; 18 to 36 per cent. passing 40 mesh screen; 25 to 55 per cent. passing 10 mesh screen; 8 to 22 per cent. passing  $\frac{1}{4}$ -inch screen; and less than 10 per cent. passing  $\frac{1}{2}$ -inch screen; the sieves to be used in the order named. (The so-called "Topeka formula"). The mixing is done in a rotary batch mixing machine specially designed for the mixing and cooking of asphaltic concrete. The mixture is cooked and stirred together from 10 to 20 minutes at a temperature of from 225 to 325 degrees F.; the mixing being continued until each particle of stone or sand has been thoroughly coated and a uniform mixture produced. The concrete is then hauled onto the roadway and spread with hot iron rakes and shovels and thoroughly rammed or tamped into position and rolled with a ten-ton roller as long as the concrete will take compression. Enough asphaltic mortar is used to fill all voids and come to the surface of the pavement when rolled. If the surface of the pavement is rough or uneven it is coated with a surface application during rolling. When the pavement is solid the entire surface is covered with a coat of Portland cement and it is specified that the rolling shall continue until there is produced "a solid semi-elastic or malleable asphaltic

concrete pavement that will be waterproof and have the malleability of lead; but that will not be so hard as to be brittle or crack during winter or so soft as to roll, creep or pick up during the summer. The specifications call for an asphalt having a ductility of not less than 10 c.m. (Dow mould); a gravity of not less than 1.0; penetration between 4 and 10 m.m. with a No. 2 needle, 100 grams; all at 77 degrees F. Twenty grams shall lose not more than 8 per cent when maintained at 400 degrees F. for 5 hours. Its solubility in carbon disulphide shall be at least 99 per cent. and in 76 degrees paraffine petroleum naphtha, distilling between 140 and 190 degrees F., shall be between 75 and 86 per cent. It shall show between 8 and 15 per cent. fixed carbon and an open flash point of not less than 350 degrees F. and shall not contain more than 1.5 per cent. paraffine scale.

Hassam grouted concrete with bituminous top is made by spreading on the sub-grade broken stone to a thickness of 5 inches at the center and 4 inches at the edges after rolling with a five ton roller; after which it is grouted with two parts sand and one part Portland cement and rolled in such a manner as to exclude all air bubbles and leave a dense waterproof concrete with a uniform rough surface. The concrete is then left undisturbed for 12 days, after which any dust is swept off and an asphaltic carpet is applied, as in the case of concrete-bituminous top.

Cementitious Hudson river gravel is a hard, durable stone which possesses self-binding qualities, that known as Pecks-kill gravel being taken as the standard. The bottom course is made of gravel varying in size from 3 inches to  $1\frac{1}{2}$  inches in diameter with just a sufficient amount of finer material to fill the voids. The top course consists of gravel varying from  $1\frac{1}{2}$ -inch to fine. This is spread to the required thickness and rolled with a ten-ton roller, being sprinkled to saturation if it is thought desirable. The top course is then spread and rolled in the same way, after which the surface is swept clean and treated as in the case of water bound macadam H.O.

In other cases the top course is composed of cementitious gravel, 70 per cent. of which passes through a  $1\frac{1}{4}$ -inch ring and over a  $\frac{3}{8}$ -inch ring, and 30 per cent. of which is gravel screenings free from dust, or clean, coarse sand; this being mixed with bituminous material A in the proportion of one cubic yard of gravel and sand measured loose to 17 gallons of bituminous material measured at 400 degrees F. The mineral aggregate is heated in a mechanical revolving dryer to between 225 and 325 degrees F., after which the bituminous material is added, heated to at least 350 degrees F. and the mixture placed in revolving mixers and thoroughly mixed and then spread upon the bottom course and raked to a uniform surface with hot iron rakes. It is then rolled with a ten-ton roller until thoroughly con-



STANDARD CROSS-SECTIONS OF NEW YORK HIGHWAYS FOR THE YEAR 1912.

solidated. The bituminous material used is California asphaltic cement and corresponds to the specifications given for this above.

"Soil-bituminous mixed" is formed by grading the roadway to an elevation 2 inches above the finished grade, at which it is left until actual construction begins, when the roadway is trenched to a depth of  $3\frac{1}{2}$  inches, the material excavated being cast partly on each shoulder. The subgrade is then rolled with a ten-ton roller until thoroughly compacted. A machine is used for heating and mixing the materials, so designed that the excavated material previously cast on the shoulders may be shoveled into it as it moves along the center of the roadway. All gravel and stone larger than  $1\frac{1}{4}$  inches in any dimension is separated and removed from the excavated material before it is shoveled into the machine. The material in the machine is pulverized by repeated violent impacts until at least 60 per cent. passes a 20-mesh screen, 85 per cent. passes a 100-mesh screen, and 95 per cent. passes a ten-mesh screen; and is dried and heated to a temperature of at least 250 degrees F. It is then mixed with bituminous material A in the proportion (by weight) of 16 per cent. bituminous material A and 84 per cent. of excavated material. The materials are then thoroughly mixed and deposited on the roadway to such a depth that, when thoroughly compacted, it will conform to the elevation and cross sections shown on the plans. It is then thoroughly rolled with a 5-ton roller until it is "waterproof, homogeneous and dense, yet malleable at air temperature." (This is a patented process.)

The brick pavements are laid on a concrete foundation and a  $1\frac{1}{2}$ -inch sand cushion, which is rolled with a 200-pound hand roller and brought to the exact form by means of a template drawn forward and backward immediately in front of the brick laying. It is provided that the blocks must have lugs on one face projecting between  $\frac{1}{8}$ -inch and  $\frac{1}{4}$ -inch and that the two ends of each block shall have a semi-circular groove from  $\frac{1}{8}$  to  $\frac{1}{4}$ -inch deep, the grooves being horizontal when the block is laid in the pavement. The abrasion loss in the rattler (N. B. M. A. standard) shall not exceed 21 per cent. and the absorption shall not exceed  $3\frac{1}{2}$  per cent. Cement grout filler is used. An expansion joint is provided along each edge of the pavement  $1\frac{1}{2}$  inches thick for a pavement 16 feet wide and increased proportionately for greater widths. The method of grouting is that prescribed by the N. B. M. A. The pavement is required to be absolutely protected from disturbance of traffic of any kind for at least 11 days.

The "bituminous material H.O." is a heavy oil which is required to meet the following specifications:

1. It shall be free from water or decomposition products.
2. The various hydrocarbons composing it shall be present in homogeneous solution, no oily or granular constituents being present.
3. The gravity at a temperature of 77 degrees F. shall not be lighter than 14 degrees Beaumé.
4. The material shall not be so hard as to show a penetration less than 30 m.m. when tested for five seconds at 77 degrees F. with a No. 2 needle weighted with 100 grams.
5. When evaporated in the open air at a temperature not exceeding 500 degrees F., until 92 per cent. of the residue remains, the residue shall not be so soft as to show a penetration more than 10 m.m. when tested for five seconds as above stated.
6. Twenty grams of it, upon being maintained at a uniform temperature of 400 F. for five hours, as stated above, shall not lose more than 8 per cent. in weight. The character of the residue at 77 degrees F. shall be smooth and nearly solid, but not so hard that it may not be easily dented with the finger, and at this temperature it shall pull to a long thin thread.
7. It shall be soluble in chemically pure carbon disulphide at air temperature to the extent of at least 99.5 per cent.
8. It shall be soluble in 76 degrees Beaumé petroleum naphtha, air temperature, to the extent of not less than 88 per cent. and not more than 94 per cent. When 20 c.c. of a naphtha solution, obtained by treating one gram of the bituminous material with 100 c.c. of cold naphtha, is evaporated upon a glass plate, the residue shall be adhesive and sticky, and not oily.

9. It shall show between 6 and 12 per cent. of fixed carbon.
10. It shall show an open flash point of not less than 400 degrees F.

11. It shall not contain more than 4.7 per cent. of paraffine scale.

Bituminous material A has the following characteristics: The first three are as for bituminous material H.O.

4. The penetration shall be between 15 and 20 m.m. when tested for five seconds at 77 degrees F. with a No. 2 needle weighted with 100 grams.

Requirement No. 7 for bituminous material H.O. applies to bituminous material A when this is a residuum or Gilsonite product, the amount soluble, however, being from 66 per cent. to 96 per cent. for natural asphalts.

7. The solubility of the bitumen at air temperature in 76 degrees Beaumé paraffine petroleum naphtha distilling between 140 and 190 degrees F. shall be between 75 and 88 per cent.

8. It shall show between 8 and 15 per cent. fixed carbon.

9. It shall show an open flash point not less than 350 degrees F.

10. It shall not contain more than 4.7 per cent. paraffine scale.

11. It shall show a toughness at 32 degrees F. not less than 15 c.m. for natural asphalts and not less than 30 c.m. for other products.

Bituminous material T is specified as follows:

1. It shall contain no tar.
2. It shall be uniform in character, appearance and viscosity.
3. It shall have a specific gravity of not less than 1.14 at 25 degrees C. if low carbon tar and 1.15 if high carbon.
4. It shall contain not more than 2 per cent. of free carbon if low carbon tar, and not more than 25 nor less than 10 per cent. if high carbon.

5. It shall contain no body that distills at a lower temperature than 170 degrees C.; not over 1 per cent. shall distill below 235 degrees C.; not over 12 per cent. shall distill below 270 degrees C. for low carbon tar nor over 10 per cent. for high carbon, and not over 22 per cent. shall distill below 300 degrees C. for low carbon nor over 20 per cent. for high carbon. In the case of the high carbon tar the specific gravity of the entire distillate shall not be less than 1.02. The residue from the foregoing distillation shall have a melting point not greater than 65 degrees F.

6. It shall have a float test (New York testing laboratory method) at 100 degrees C. between 15 and 25 seconds.

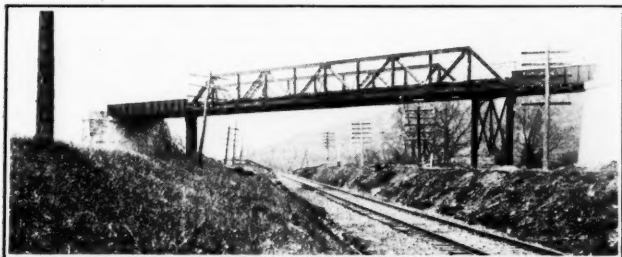
The broken stone used by the commission is designated as screenings, material which passes through  $\frac{5}{8}$ -inch circular openings; No. 2, that which passes through  $1\frac{1}{4}$ -inch openings; No. 3, that which passes through  $2\frac{1}{4}$ -inch openings; and No. 4, that which passes through  $3\frac{1}{2}$ -inch openings. Dust is considered to be material which will pass a screen having openings  $\frac{1}{8}$ -inch square.

A laboratory for testing road materials is maintained by the Highway Department, where all materials except cement are tested. Cement tests are made by the Bureau of Research, another division of the State government. The highway laboratory is located in two large rooms in the basement of the department headquarters building. In one room the tests of brick and stone are made; in the other room, tests of asphalt and tar and other chemical and the more delicate physical tests are made. The principal physical tests on material intended for use as road metal are the following: Abrasion—which consists in revolving the stone in iron cylinders in the machine commonly used for the purpose and calculating the loss in weight. Hardness, which consists in grinding a cylinder of stone on an emery surface for a certain time and calculating the loss in weight. Impact, which consists in breaking a cylinder of stone on the Page impact machine; in this test a weight of about  $4\frac{1}{4}$  pounds is dropped onto the cylinder from successive heights of one, two, three, etc., centimeters until the cylinder breaks. The cementation test, often made on this machine, is not much used in this laboratory for two reasons—First, it is thought that when bitumen is the binding material the cementing quality of the stone itself is of minor importance; second, some doubt is felt as to the value of the test, for as high results have been obtained in tests made on cylinders of pulverized silica as on those of powdered limestone, and experience seems to show that high tests are more the result of fine-



ness of the grinding than of the composition of the stone.

The tests of the bituminous materials are similar to those usually made. Water, if present, is noted as well as the homogeneity and specific gravity of the cement. The penetration of the A material (asphalt cement) is taken (about 150 degrees at 77 F. is what is desired). In testing H.O. (road oil), the penetration is taken after 8 per cent. has been distilled off at a temperature of 400 degrees Fahrenheit in five hours. Ductility tests are made of the A material and the residue of the H. O. after distillation. A



BRIDGE ELIMINATING GRADE CROSSING.

specified maximum of evaporation at a given temperature is allowed for each of several grades of material. For example, 4, 8, 12 and 15 per cent. losses are permissible for different grades of bitumen at 325 degrees F in five hours. Losses of 8, 12, 20 and 30 per cent. are permissible for the same grade at 400 degrees F. in five hours. The percentage of material soluble in carbon disulphide and petroleum naphtha is noted and certain standards required. Open flash tests are made at 200 and 350 degrees F. The percentage of paraffine is ascertained and maxima of 3 and 4.7 per cent. established for H. O. and A material respectively.

One test of asphalt which is well thought of has been practised for about a year by Mr. Meyer, who is in charge of the laboratory. This is an impact test made on the Page machine on a ball of frozen asphalt about two inches in diameter. The balls of asphalt kept in crushed ice for three hours and then placed in a tin dish with some ice about it, are placed under the hammer of the machine. Blows are delivered at 5, 10, 15, etc., centimeters. Samples of H. O. tested in this way break at as high as 30 centimeters.

#### RECENT CONSTRUCTION WORK.

The county highway in Columbia County, running from the city of Hudson east to the State line, a distance of about 19 miles, shows the system of bituminous construction by the penetration method practised by the State Highway Department as it has been modified from year to year. The road was divided for construction purposes into three sections. The first begins at the city line at an elevation of about 200 feet above the river, and extends 5.6 miles east to Hollowville, where the elevation is 350. This section

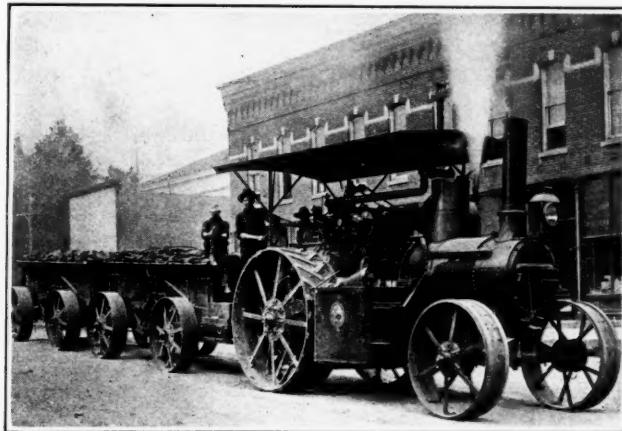


A WELL ARRANGED CRUSHING PLANT.

was built in 1908. The next section, from Hollowville to Craryville, elevation 600, 7.1 miles long, is now under construction, and a third section, from Craryville to the State line, elevation 1,000, 6 miles long, was finished in 1911.

The first section, Hudson to Hollowville, consists of a bituminous roadway 16 feet wide, with 3 feet shoulders of dirt on each side. The bituminous roadway has a base course of 2½-inch stone 3 inches thick and a top course of 1½-inch stone, also 3 inches thick. This top course, after rolling, was covered with Bermudez asphalt cement, 1¼ gallons per square yard, and sufficient screenings placed over it to prevent the steam roller from sticking. Over this was placed a second application of Bermudez asphalt, ½ gallon per square yard, the top again being covered with fine screenings to prevent adhesion to the roller. The bituminous roadway was given a crown of from 6 to 8 inches.

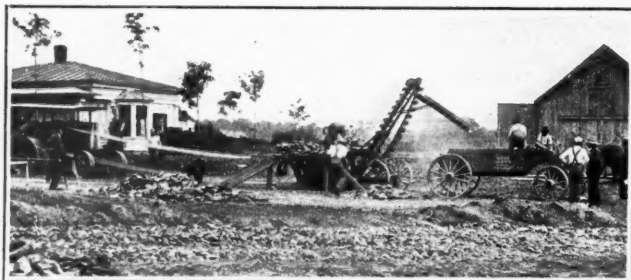
This pavement, nearly three years old, is in excellent condition, and gives every indication of being a serviceable and durable pavement. Last winter the frost was unusually deep, and a few places where the banks are high and the ditch is not very deep have broken up. Probably 100 square yards of patching will repair the damage. Some slight disintegration along the edges is noticeable in places. When visited last week by the writer no defects were apparent anywhere due to the failure of the roadway to withstand the traffic. However, changes in construction have been made in more recent work, designed to overcome objections that have been made to this and similar roads. It has been objected that the pavement is hard and slippery, although this criticism would hardly be made of it in the city where horses are accustomed to travel on paved streets. However, the crown has been lowered in the more recent work. It has been found that drivers of light vehicles prefer to



TRACTION ENGINE AND CARS ON ROAD WORK.

travel on the shoulders of the road and leave the asphalt section to automobiles and heavy wagons, which never use the shoulder. To overcome the objection of slipperiness ¾-inch stone instead of fine screenings are used, and to overcome the objection of hardness of surface, hot road oil is used for the second application of bitumen instead of asphalt cement—"A Material," as it is called. In recent work the shoulders are made 6 feet wide instead of 3 feet, and of gravel if it is available. The bituminous roadway is also made narrower in some places.

The third section of this county highway, which was finished last year, includes some of the modifications and improvements just mentioned. The asphalt roadway is 16 feet wide, and there are dirt shoulders 5 feet wide on each side. The bottom course, of 2½-inch stone, is made 4 inches thick instead of 3, as in the first section. The upper course of stone, 2 inches thick, was made of 1½-inch stone, as before, the total thickness of both layers being 6 inches in each case. The stone spread over the first course of bitumen was in this section of ¾-inch size, the purpose



SMALL PORTABLE CRUSHING PLANT.

being to provide a rougher surface that would afford a better foothold for horses. The bitumen was of the same consistency in both layers, and the same as in the first section. The asphalt for this work was supplied by the Standard Oil Co. A crown of 4 inches was given to the asphalt roadway. This height of crown makes an excellent appearing roadway, and drains off the water freely, and with a possible exception of grades of 4 per cent. and over is in accordance with what is generally considered desirable in city practise. There does not seem to be any very obvious reason why the crown of the highway should be any different from that of a city street of the same width.

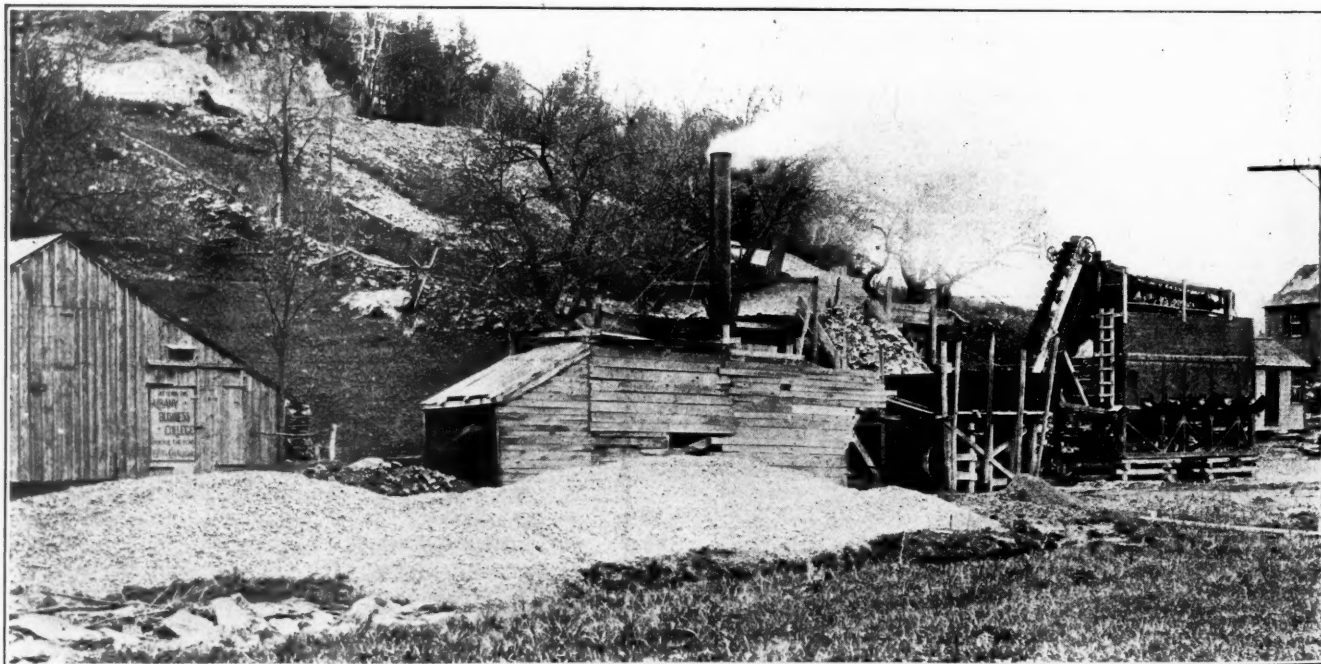
Of the second or middle section, from Hollowville to Craryville, now under construction, some sections have been finished. The asphalt strip here has been reduced to a width of 12 feet, and the shoulders, made of gravel 6 inches deep, are 6 feet wide. The depth of stone laid as a base has been increased to 9 inches, consisting of two layers, the lower layer, or "sub-base," as it is called in the highway department, is 6 inches thick, composed of large and small stone, forming a rough sort of Telford. Special care is taken to lay large stones at the margin. Over this layer, after rolling, 3 inches of crushed stone, 2½ inches and finer, is spread and rolled. Then 1¼ gallons per square yard of material A—that is, asphalt cement of about 100 or 150 penetration—is poured. Fine stone, ¾-inch size, is spread over this and rolled. Any loose surplus stone is swept off before the second coat of ½ gallon per square yard of road oil—called H.O.—is applied. The sweeping is a new requirement. Screenings or coarse sand are spread over this to prevent the roller from sticking. The crown of the bituminous strip varies from 2 to 3 inches.

This makes a rather flat appearing road, particularly where the percentage of grade is slight.

The Hollowville-Craryville road is being built by Di Martino & Musso, of Scranton, Pa. The resident engineer is F. A. Biggi. The engineer of the division is Paul McClaud. The road is 7.1 miles long, and will cost about \$108,000, about \$15,000 per mile. As would be expected from the hilly nature of the county, the construction is very heavy. It includes two extensive relocations of the road. In one place the new road will be 30 feet above the old one, and at one point 300 feet from it. In another place a railroad grade crossing has been eliminated, the railroad company having built the bridge but the fill being included in the contract for the road, which fill will require 30,000 cubic yards of earth and will be 20 feet deep at one point. The total excavation in the whole contract will amount to 75,000 cubic yards. There are many streams crossing the roads, some of them of considerable size, and 50 culverts altogether will be built to take care of the water. Altogether 1,600 cubic yards of concrete will be used in this part of the work. One of the culverts has a 20-foot span, consisting simply of a flat slab, reinforced, 18 inches thick. This has been tested in a practical way by the passage of the contractor's steam roller, weighing 15 tons, which did no damage.

The contractor is doing nearly all of his excavation with a Thew portable steam shovel. This shovel handles about 200 cubic yards of earth per day on ordinary work. The daily labor cost of operation is as follows: Engineer, \$5; fireman, \$2.50; two men tending machine and putting planks under wheels, \$3.50; a cost per cubic yard of 4½ cents. The bucket ordinarily handles a half cubic yard at one time. If the excavation is light—less than 3 feet—it is difficult to take a full bucket at one time without digging below grade, but the contractor says it pays him to use the shovel on cuts of about 18 inches and over. One Etnyre sprinkling wagon is used as a water tender of the shovel.

The stone crushing plant consists of an Acme portable outfit having a capacity of about 150 cubic yards per day. It has been equipped with special steel jaws at considerable expense. The location of the crushing plant is a little peculiar, the quarry being on higher ground than the crusher and directly back from it. The stone is hauled in carts a short distance and dumped into a chute about 10 feet long, delivering onto the feeding platform. (The location of the



PORTABLE CRUSHING PLANT AT HOLLOWVILLE

Quarry at left side of picture.



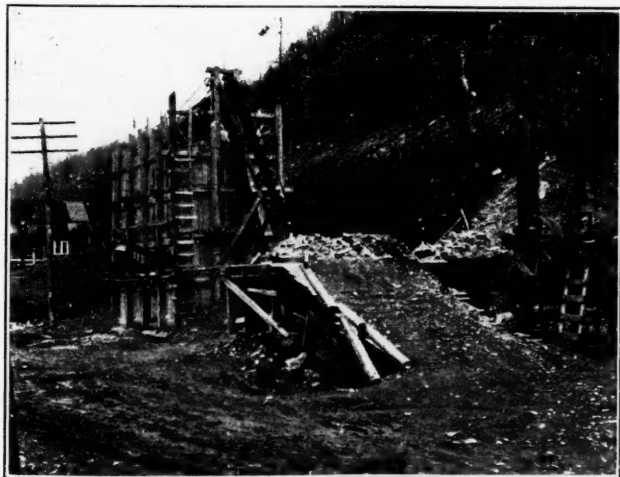
crusher illustrates one of the difficulties which contractors complain of regarding the highway work generally. The farmers along the line of the work sometimes have an exaggerated idea of the value of the facilities which they control, such as quarries, gravel banks and even water. In this place there was a more convenient location for the crusher, but the farmer wanted too much for it.) The contractor's quarrying outfit consists of five Ingersoll-Rand drills, a Farquhar boiler and a portable blacksmith's shop. The rock in the quarry which is now being worked is quartzite. Later the crusher will be moved to another location, where there is a very hard limestone.

The rolling and transporting outfit consists of a 10-ton Geiser roller and a Farquhar traction engine. About 25 wagons and three carts are used. The traction engine can pull eight wagons in a train. A large part of the hauling, however, is done by teams hired from the farmers at \$5 per day. Traction trains can be used to much greater advantage in hauling crushed stone where the 6-inch sub-base is used than in the old form of construction of two 3-inch layers of smaller stone.

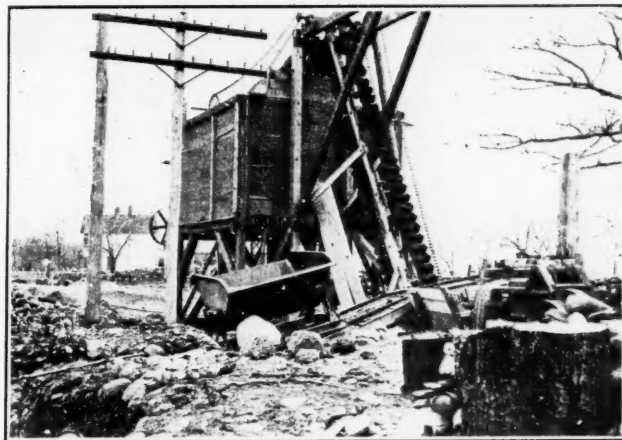
For melting the asphalt two 400-gallon Acme kettles are used. These are provided with a simple crane for hoisting the barrel. The pouring is done by hand, with ordinary pouring cans.

Two adjoining contracts for asphalt macadam construction on the State highway between Albany and Buffalo, near Hoffmans, Schenectady County, illustrate the way in which the engineers of the Highway Department vary the method of construction to take advantage of road materials that are available. The construction is grouted asphalt macadam, like that described above on the Hollowville-Craryville road. The work is done under the old specifications, but in the portions to be done this year the heavier base construction is used—that is, the six-inch sub-base instead of the former three-inch. The asphalt used is A material for both coats, and the contractors for both sections are using the Standard Oil Company's asphalt.

The two sections join at a point near Hoffman's station on the New York Central Railroad. The western section, two and a half miles long, is generally level, following closely the line and grade of the railroad. The land rises sharply on the north, with occasional limestone ledges showing. One of these ledges approaches the line of the road, forming an obstruction to the view. Near this the contractor, Thomas Carr, of Troy, N. Y., placed his crushing plant. It is a number 2½ Climax outfit capable of crushing about 160 to 180 yards per day. The rough stone is hauled to the crusher, the immediate approach being a rather steep incline.



CRUSHING PLANT NEAR HOFFMAN'S.



GRAVEL CRUSHING AND SCREENING PLANT, NEAR HOFFMAN'S.

The contractor's plant is especially interesting, as he is one of the oldest contractors in point of service employed by the State Highway Department and therefore may be assumed to know what is best for such work. Only five or six teams are employed on the job and these are hired from farmers and others in the neighborhood. He does all the hauling possible with traction engines. Mr. Carr states that in the old days he had as many as fifty or sixty horses on his work and made no faster progress than he does now with half a dozen teams or less and two traction engines. The transportation outfit consists of two Buffalo-Pitts traction engines, two Buffalo-Pitts traction cars and twenty-five bottom-dumping wagons of various makes. A number of wagons are drawn in a train with the cars. The Buffalo-Pitts cars spread the stone for the upper three-inch base course, delivering their load along the center of the macadamized strip. The wagons are pulled on to the shoulders of the road, where they are unloaded, supplying the material for the sides of the strip. Mr. Carr states that with a skilled man in charge there is no trouble in spreading the stone accurately in this way. Other items of the plant include a Rider hot-air engine and pumping outfit located near the crusher, two ten-ton Buffalo-Pitts steam road rollers, two Ingersoll-Rand steam drills, and three 100-gallon Iroquois tar tanks.

East from Hoffman's station the highway does not follow the railroad so closely. It ascends over hills of glacial drift composed of gravel and sand. There are no outcroppings of rock in sight. Hence the construction is modified and gravel is used throughout. The gravel plant is interesting. A pit was located near the middle of the section of road under contract. The plant of the contractor, Joseph Walker of Albany, consists of an Acme crusher and engine, portable bin and screen, and a track leading down into the pit on which Koppel side-dumping cars are run. The crusher platform is quite low, only a few feet above the road. The gravel, which contains many cobblestones, is dumped from the car onto a grating of iron bars covered with sections of iron pipe which are easily replaced when worn out. The larger stones are fed into the crusher and the finer material dropped on to a conveyor belt which carries both the broken stone and gravel to the elevator, which raises it to the screen, where it is separated and dropped into the pockets of the bin. For loading the gravel cars, no mechanical device was used at first. The gravel under and near the track was excavated first and the end of the track gradually dropped. Arrangements are being made, however, for installing a Bishop excavator. This device consists of a derrick, with a dipper and handle similar to that used on a steam shovel fitted to the boom. This permits of excavating from a large area before it is necessary to move the derrick to a new location.

## ROAD EXPERIENCE IN SEVERAL STATES

### Conclusions of Fifteen States, from Experience, as to the Most Valuable Kinds of Road Construction— Use of Convicts

EXPERIENCE in new methods of road construction and in the application of old methods to new traffic conditions are being accumulated rapidly by a number of State highway commissions, which experience other commissions, which have been in existence only a few months, are endeavoring to utilize until they shall have demonstrated by actual test the methods and materials which give most satisfactory results under their particular climatic and geological conditions. From several of the State highway commissions we have obtained statements as to their conclusions based upon past experience, which we summarize below.

Concerning methods of construction which are considered to have fully demonstrated their value, Alabama reports macadam, chert, gravel and sand-clay as coming under this head. In Illinois water-bound macadam with gravel binder, bituminous macadam (penetration method), brick and concrete are reported. The Iowa commission has not yet had sufficient experience to determine. In Kansas earth road, graded and dragged; oil earth roads, gravel, water-bound macadam, bituminous macadam and sand-clay are included in this class. In Louisiana clam shell, gravel, sand-clay and well drained earth. In Maine gravel, plain macadam and bituminous macadam. In Maryland plain macadam, consisting of gravel, oyster shells or broken stone or a combination of any two of these; surface treatment of these with tar or asphalt, and the penetration method. In Michigan gravel and water-bound macadam. In Nevada State supervision has just commenced, and no experience has been acquired. In New York no methods are considered entirely satisfactory, when cost of maintenance is considered. In South Dakota earth roads only have been constructed by the commission. In Vermont gravel and gravel Telford are the standard. In Washington and Wisconsin the experience of the commission has been too short to decide.

While the above named are believed to have proved their value, there are in many States classes of construction which have been tried for only a year or two, but which so far have appeared to be fairly satisfactory. As such Maine names 6-inch concrete, surfaced with refined tar, and sand clay. Maryland names sampittic surfacing (mixture of pitch with sand), and concrete with a bituminous carpeting. Michigan, concrete for heavy travel. New York includes under this head water-bound macadam with hot oil for light traffic, and for heavy traffic bituminous macadam (penetration or mixing method), "Rocmac," concrete (plain and metallic base) with bituminous top, and brick. The Washington State Commission places under this head Warrenite and oil macadam (mixing method) for heavy traffic, water-bound macadam for light traffic, and clay-bound gravel where there is considerable rainfall. The Wisconsin commission, which has had less than two years' experience, approves of water-bound macadam and gravel.

In some of the States the commissions are expecting to test this year materials which they have not heretofore tried. Among these, Louisiana expects to test petrolithic with a tamped base; also a wearing surface of washed gravel bonded with 80 per cent. asphaltum oil. New York does not expect to try any methods not previously used, but will construct a considerable amount of concrete with bituminous top, which kind of construction has already been laid as an experiment. Washington is to try brick, and also concrete with a bituminous carpet, although this will be largely county rather than State work. Wisconsin is to

employ concrete and bituminous construction for the first time.

For repairing or prolonging the life of the existing roads the split-log drag is used in Maine on earth and gravel roads and refined coal tar on macadam, but most of the maintenance is done by the towns. In Vermont the gravel roads are regaveled, care being taken to maintain a good crown. In New York hot oil and screenings are considered to have proved their value, while one or two years' test has apparently demonstrated the effectiveness of the plan of scarifying, adding new stone and grouting with 1:2 Portland cement mortar, then putting on a thin bituminous top or a metal base top. During the present year the commission expects to completely resurface a number of macadam roads. In Maryland the use of pitch compounds, either by surface treatment after construction or by penetration method during reconstruction, is considered as standard, while small but fairly satisfactory experiments have been made in the use of calcium chloride and of glutrin. Alabama has for a year or two been using bituminous materials for this purpose. Louisiana repairs its clam shell roads by cleaning the surface thoroughly, loosening and reshaping, adding new shell, rolling, sprinkling and rolling again, and stone and gravel macadam roads are repaired in the same way, using the several materials employed in the construction. In Kansas scarifying and resurfacing macadam is the standard practise, but during the past year or two bituminous macadam has been repaired by cleaning the surface, applying crushed rock and just enough oil to fill the voids, and placing on this a coat of sand or screenings. In Washington the gravel roads are repaired by plowing, harrowing, resurfacing with fresh gravel and shaping the crown with drags; during the past year or two macadam has been repaired by scarifying, reshaping and rolling, and covering with Warrenite or claybound gravel, while oil-mixed macadam is sprayed with hot oil or Tarvia, covered with coarse sand and rolled. In Wisconsin one or two seasons' experience has been had with oiling the roads with various bitumens.

Dust alleviation is not generally considered as a part of the State work, but rather a part of the maintenance which is in charge of the counties or towns. In a few of them, however, more or less of this work is done. In Colorado only water is used for this purpose. In Kansas water sprinkling is the only standard method, but during the past year or two a trial has been made of thoroughly sweeping off the dust, applying 60 per cent. asphalt oil at the rate of one-third gallon per square yard, and covering this with just enough sand or screenings to absorb the excess of oil. In Michigan a light oil surface treatment has been used for a season or two. In New York State a treatment with both hot and cold oils has been accepted as standard; glutrin has been used for one or two seasons, and the commission expects to make a trial of calcium chloride during the present year. In Washington the commission has tried nothing for this purpose other than water sprinkling.

One of the questions asked of the several commissions was whether they had used any new mechanical appliances during the past year in their road work, and it is worthy of note that the only States reporting new machinery, Illinois, Maine and New York, each named a pressure sprayer for applying bituminous materials as the only or principal new apparatus.

The use of prisoners in road construction is being advocated by one at least of the national organizations. In some States they have been so used for a number of years, in others the plan is being tried on a small scale. In Alabama prisoners are used by cities and counties to some extent. In Colorado State convicts are used on the patrol system, without guards, in camps of 30 to 50, each camp in charge of a superintendent. Sentence is reduced for good conduct at the rate of 10 days for each month of road



work for the first six months and 15 days for each month after that. Few escapes have been attempted. In Illinois prisoners are now used only in preparing crushed stone in two quarries owned by the State. In Kansas the county in which the State penitentiary is located has used 50 to 60 consumptive convicts on road work for the past three years, the Colorado plan being employed. In Louisiana both State and parish prisoners are used in road work. In Michigan prisoners are used by counties only to a certain extent. In Montana they are used under county supervision upon the application of the county authorities. In Nevada they are used for State roads. In New York they have been used on a few county and town roads. In Vermont they can be so used, but are not. In Washington State prisoners have been used for constructing State roads, but at present they are used only at the State rock-crushing plants.

## OHIO EXPERIMENTAL ROAD

### Conditions of Seventeen Kinds of Road Construction After Two Years' Service—Amount of Wear

IN our issue of January 4, 1911, we described the experience had with an experimental road which had been constructed by the Ohio State Highway Department during the summer of 1909, the report from which this article was prepared telling by photographs as well as by words the conditions of the several sections after a year's use. This road consisted of 17 sections of Nelson avenue, Columbus, each of which was treated in a different way, the sections being numbered consecutively from one to 17. A traffic census was taken daily from November 29 to December 12, 1909, between the hours of 7 a. m. and 5 p. m. As the weather at this time was cold and inclement it is believed that the traffic was considerably less than the average. This census showed for the 14 days 690 one-horse buggies, 78 two-horse carriages, 641 one-horse wagons, 618 two-horse wagons, 14 runabout automobiles, 637 touring cars, 15 motorcycles and 54 horseback riders. The maximum number in one day was on Sunday, when there were 237 vehicles and 27 horseback riders.

A second report on the Nelson avenue experimental road was prepared last November, after somewhat more than two years' service, and although it has not yet been published we are permitted to give the following information from it:

The majority of the sections present a smooth, uniform surface and are in satisfactory condition. The various binders have retained their life; and are holding the stone in place in acceptable manner. The irregularities in surface, in most cases, are due to faulty methods of construction rather than imperfections of the binder. Some trouble was experienced with a few of the treated sections during the summer months, due to the exuding of the binder commonly spoken of as "bleeding."

In justice to the sections located near cross or branch roads it may be said that considerable mud and dirt are carried onto these sections by the wheels of vehicles coming from adjoining earth roads. The sides of these sections also receive more traffic than do the corresponding portions of sections on which there are no road approaches.

A brief description of each section as it appears at the present time is here given.

*Experiment No. 1—Glutrin.*—This material is classed as a temporary surface treatment, the manufacturers claiming that it should be renewed at intervals. The glutrin, being soluble in water, has long since disappeared. This section was surface treated with oils during the summer of 1911. The surface at present is in good condition.

*Experiment No. 2—Standard Asphalt Binder.*—The binder on this section bled slightly during warm weather. The surface is in fair condition.

*Experiment No. 3—Pioneer Asphalt.*—The surface of this section is smooth and in very good condition. Considerable mud is carried onto the surface from intersecting roads during wet weather.

*Experiment No. 4—Tarvia "X."*—The surface of this section is slightly irregular. The stones appear to be firmly held by the binder. The mud and dirt which show on the surface have been carried from adjoining roads by the wheels of vehicles.

*Experiment No. 5—Tarvia "B."*—Although this material is classed by the manufacturers as a temporary treatment, it is still in excellent condition after two years' wear.

*Experiment No. 6—Liquid Asphalt.*—The stones are firmly held in place by the binder and present a smooth, uniform surface.

*Experiment No. 7—Ugite.*—This section is in very good condition, the stones being held together and no excess of binder appearing on the surface.

*Experiment No. 8—Fairfield Asphaltic Cement.*—The surface of this section is rather irregular. Under the Pennsylvania Railroad crossing imperfections in drainage have caused a few small depressions. The binder appears to be holding the stones firmly in place.

*Experiment No. 9—Asphaltoile.*—A break in a water main under a portion of this section caused a settlement which was never properly repaired. The binder on this section "bled" considerably during warm weather. The surface is rather irregular, due to a large extent to faulty work in construction.

*Experiment No. 10—Wadsworth Macadam.*—This section is in very fine condition, the surface closely resembling a sheet asphalt pavement.

*Experiment No. 11—"Carbo Via."*—An excess in screenings which were left on the surface of this section during construction has entirely disappeared, leaving a wearing surface of large stone held together by the binder.

*Experiment No. 12—Concrete Macadam.*—This section was treated in the early summer of 1911 by the Solvay Process Co., which used a calcium chloride solution. The purpose of this treatment was to prevent the accumulation of dust by keeping the road damp. Up to the present time this treatment has given satisfactory results.

*Experiment No. 13—Taroid.*—This section is in very good condition. It presents a smooth, hard, uniform surface.

*Experiment No. 14—Petroolithic Pavement.*—During the summer of 1910 the surface of this section was covered with gravel in an attempt to take up the excess of the binder that was exuding from the road. This section continued to "bleed" during the summer of 1911. The surface was soft and became badly rutted. At the present time the surface is irregular and is not in a satisfactory condition.

*Experiment No. 15—Limestone Concrete.*—The surface of this section is irregular. Parts of the roadway have worn badly while others are in fair condition. The results of this experiment would indicate that it is not practical to use a rolled dry mix concrete for road construction.

*Experiment No. 16—Gravel Concrete.*—The surface of this section is smooth and shows little indication of wear except at one point, where a portion of the concrete was cut out in order to permit the laying of a drain across the road. Transverse contraction cracks have developed at more or less regular intervals across the road. The result would indicate that the wet mix was preferable to the dry mix used in experiment No. 15. A bituminous surface treatment would undoubtedly add greatly to the merits of this type of roadway.

*Experiment No. 17—Waterbound Macadam.*—The surface of this section is rather irregular and rough. The heavy automobile traffic has removed a large portion of the limestone binder.

In order to provide a record of the wear on the different sections, levels were taken over the road on December 22, 1909, soon after the completion of the work. The points at which the levels were taken were carefully located, so that it is possible to ascertain the amount of wear by re-leveling at any time. Readings were taken on the center line, and at 4 feet and 8 feet, both east and west of centers, at five stations on each section, making a total of 25 readings on each section of 400 feet.

The work was relevelled in September, 1910, and again on November 11, 1911. The differences in elevation are shown in hundredths of a foot in the annexed table, and the amounts are the average of five points on each section. Plus reading indicates that the surface at the particular points noted was higher at the time the second levels were taken than when the first observations were made.

Several causes contribute to the differences between the elevations noted on December 22, 1909, and November 11, 1911, respectively.

1. On December 22, 1909, the day on which the first levels were taken, the ground was frozen to a depth of several inches, while on November 11, 1911, the day on which the last set of levels were run, there was no sign of frost. The frost on December 22, 1909, undoubtedly caused the road surface to be higher than when there was no frost present.

2. The wear resulting from traffic naturally would lower the surface of the road.

3. The exuding of the binder on the treated sections

during the warm weather caused a raise in surface elevation at many points.

4. The surface of the sections located near intersecting roads has been raised somewhat by mud being carried onto the roadway from adjoining earth roads.

5. Many of the treated sections were covered with an excess of screenings when first completed. These screenings rapidly wore away until the wearing surface of large stone were exposed. This resulted in a rapid rate of wear for the first year.

Causes 3 and 4 tend to counteract the effects of causes 1, 2 and 5.

TABLE SHOWING WEAR ON THE NELSON AVENUE EXPERIMENTAL ROAD FROM DECEMBER 22, 1909, TO NOVEMBER 11, 1911

Section.	8 ft.	4 ft.	Center	4 ft.	8 ft.
	east.	east.	line.	west.	west
1. Glutrin .....	.08 ft.	.09 ft.	.05 ft.	.01 ft.	.04 ft.
2. Standard asphalt .....	.04 ft.	.10 ft.	.06 ft.	.06 ft.	.09 ft.
3. Pioneer asphalt .....	.05 ft.	.03 ft.	.03 ft.	.03 ft.	.08 ft.
4. Tarvia "X" .....	.01 ft.	.05 ft.	.06 ft.	.08 ft.	.05 ft.
5. Tarvia "B" .....	.08 ft.	.03 ft.	.04 ft.	.03 ft.	.04 ft.
6. Indian asphalt .....	.01 ft.	.06 ft.	.05 ft.	.06 ft.	.05 ft.
7. Ugite .....	.05 ft.	.08 ft.	.09 ft.	.08 ft.	.05 ft.
8. Fairfield asphalt .....	.06 ft.	.08 ft.	.07 ft.	.06 ft.	.02 ft.
9. Asphaltoilene .....	.08 ft.	.05 ft.	.07 ft.	.10 ft.	.09 ft.
10. Rock asphalt .....	.11 ft.	.05 ft.	.06 ft.	.07 ft.	.09 ft.
11. Carbo via .....	.02 ft.	.11 ft.	.12 ft.	.12 ft.	.07 ft.
12. Concrete .....	.06 ft.	.08 ft.	.08 ft.	.05 ft.	.07 ft.
13. Taroid .....	.04 ft.	.09 ft.	.10 ft.	.08 ft.	.03 ft.
14. Petrolithic .....	.04 ft.	.02 ft.	.08 ft.	.05 ft.	.03 ft.
15. Limestone concrete .....	.05 ft.	.04 ft.	.03 ft.	.01 ft.	.05 ft.
16. Gravel concrete .....	.01 ft.	.00 ft.	.01 ft.	.01 ft.	.05 ft.
17. Waterbound macadam .....	.04 ft.	.08 ft.	.08 ft.	.06 ft.	.04 ft.

## USE OF BITUMENS FOR ROADS

### Review of the Use of Bituminous Materials in the Construction and Maintenance of American Highways During 1911—Extent of Use—Surface Treatment—Penetration Methods—Bituminous Concrete

Paper Before American Association for the Advancement of Science by ARTHUR H. BLANCHARD, M. Am. Soc. C. E.,  
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As considerable confusion arises because of misunderstanding of the various expressions and terms used in describing materials and methods of construction, certain definitions are given in order that the content of the description as set forth below may be manifest to all. The nomenclature used in this paper covering bituminous materials and their use in the construction of roads and pavements follows:

Bituminous concrete pavements are those having a wearing surface composed of stone, gravel, sand, shell or slag, or combinations thereof, and bituminous materials incorporated together by mixing methods.

Bituminous gravel pavements are those composed of gravel and bituminous materials incorporated together by penetration methods.

Bituminous macadam pavements are those consisting of broken stone and bituminous materials incorporated together by penetration methods.

Bituminous surfaces consist of superficial coats of bituminous materials with or without the addition of stone or slag chips, gravel, sand or materials of a similar character.

In order to give some idea of the extent of the use of bituminous materials in the construction of roads and pavements in the United States, the superficial yardage of roads maintained by surface treatments, of bituminous pavements constructed by penetration methods and of bituminous concrete pavements built under the jurisdiction of the State Highway Departments of Maine, New Hampshire, Massachusetts, Rhode Island, New York, New Jersey, Pennsylvania and Maryland during 1911 is given. In the follow-

ing table the yardage for 1908, 1909 and 1910 is included for comparison:

	Tars and tar-asphalt compounds.	Medium and heavy asphaltic oils and asphalt cements.	Light asphaltic oils.
SURFACE TREATMENT OF ROADS			
1908 .....	57,700	239,500	.....
1909 .....	95,500	910,600	4,125,900
1910 .....	123,400	2,434,200	9,890,400
1911 .....	433,700	7,980,400	3,765,200
BITUMINOUS PAVEMENTS CONSTRUCTED BY PENETRATION METHODS:			
1908 .....	37,800	25,200	.....
1909 .....	170,200	2,077,400	.....
1910 .....	339,300	4,840,200	26,500
1911 .....	121,900	8,680,900	.....
BITUMINOUS CONCRETE PAVEMENTS			
1908 .....	52,100	4,400	.....
1909 .....	136,000	219,500	.....
1910 .....	158,000	432,600	.....
1911 .....	24,400	508,100	.....

As under the Rhode Island State Board of Public Roads no construction work was accomplished during 1911, owing to the fact that no road appropriation was made by the Legislature, the yardage of bituminous concrete pavements constructed with tar and tar-asphalt compounds in 1911 shows a decrease in comparison with the yardage recorded for 1908, 1909 and 1910, the bulk of which was built by the Rhode Island Board. It is of interest to note, however, that 750,000 gallons of refined tar have been ordered to be used in the construction of bituminous concrete pavements in Rhode Island during 1912. That more permanent forms of construction are favored by our State commissions is



clearly shown by the marked decrease in the use of light oils for surface treatment of roads and the decided increase in the surface treatment of roads with heavy asphaltic oils and asphalt cements. As showing the general increase in the use of bituminous material in the construction of bituminous surfaces and bituminous pavements for 1909 to 1911, the total figures for the four years are given. The total number of square yards for each of the above years is given in the following table:

1908 .....	416,700
1909 .....	7,735,100
1910 .....	18,244,600
1911 .....	21,514,600

These totals include the yardage of road surface treated with light asphaltic oils. A comparison of more value and representing material progress along the lines of improved methods of construction and maintenance should be based on totals from which the yardage of road surface treated with light asphaltic oils is omitted. On this basis the total yardage is as follows:

1908 .....	416,700
1909 .....	3,609,200
1910 .....	8,327,700
1911 .....	17,749,400

#### SURFACE TREATMENT.

As noted above, one line of development in the surface treatment of roads has been the departure from the use of palliatives and a marked increase in the use of bituminous surfaces. This tendency is due in part to the unsatisfactory results which have accrued from using bituminous materials which did not "set up" in from twenty-four to forty-eight hours, to the necessity for repeated closing of thoroughfares and to the recognition on the part of many that bituminous surfaces are more economical and efficacious in the long run than treatments with palliatives. This change is not only characteristic of State work, but is even more characteristic of municipal work where the tracking of bituminous materials results on the whole in more material damage to property.

The second marked development under the bituminous surfaces is in the increased use of various types of pressure and gravity distributors which have been specially designed for this work. The consequent abandonment of the use of pouring cans and ordinary watering carts for this work is to be commended. Many types of these machines have been used during the past year for this kind of work. It has been unfortunate that sufficient information has not been at hand covering the use of these various machines so that an engineer might know the limitations of a machine before purchasing. It is self-evident that, given the kind of bituminous material, the temperature of the material, the rate at which the distributor travels, the calibration of the distributor should be such that the operator will know how much it will distribute per square yard. Information of this character will without doubt be forthcoming with reference to many of the distributors to be used during the season of 1912. Extravagant claims have been made by the designers and manufacturers of distributors. In a certain instance it has been claimed that materials, ranging in character from light oil to an asphalt cement of a consistency suitable for use in the construction of sheet asphalt pavements, could all be distributed by a given machine in amounts per square yard varying from one-eighth of a gallon to two gallons. Recently the writer's attention was called to the fact that a certain designer was recommending the use of a pressure distributor which necessitated the use of a steam roller in its operation, for the distribution, as a surface application, of a palliative which is always applied cold.

During 1911 bituminous surfaces have not only been used extensively on macadam and gravel roads, but they have also been used to a considerable degree on cement-concrete pavements. The improvement of the concrete pavement by the addition of the bituminous surface is

marked, as, if the proper kind of bituminous material is used, the pavement is non-productive of dust, is not slippery, and is less noisy than the ordinary concrete pavement. There is no apparent reason why the results accruing from the use of bituminous surfaces on brick pavements would not be equally good. Especially would such be the case where bituminous fillers are used, thus combining many of the advantages of bituminous fillers and bituminous surfaces with the inherent good qualities of brick pavements.

#### PENETRATION METHODS.

The construction of bituminous pavements by penetration methods and numerous methods which have been employed during 1911 all have as the principal desiderata the keeping of the bituminous material within two inches of the road surface and the securing of the uniform incorporation of the bituminous material and the broken stone. Due to the lack of uniformity in the density of the surface, and in the amount of bituminous material applied by the many methods employed, it is obvious that the uniform incorporation of the road metal and the bituminous cement is difficult to obtain. The average pavement has been generally built in two courses, the foundation course being about four inches thick after rolling and the top course about two inches thick after rolling. Following are brief descriptions of the various methods to which reference has been made. In all the methods the construction is completed by the application of a thin coat of sand, stone chips or screenings.

Type A.—For the upper course, broken stone is used containing sufficient small-sized particles to materially reduce the voids, as, for instance, crusher run stone, which passes a one and a half inch screen, and is supposed to be retained on a half-inch screen. In this method, after the upper course is laid, the bituminous material is applied either before or after the surface is rolled, some favoring the former because of the greater depth of penetration secured. When the upper course is rolled after the application of bituminous material, a coat of mineral matter has usually been spread over the surface before rolling. The necessity for a second application or seal coat of bituminous material is determined by traffic conditions in many cases, although standard practise in some departments is responsible for the use of one or the other methods, independent of the traffic.

Type B.—In case the metal of the upper course is a uniform product of about one inch or one and a half inches in size, the bituminous material is applied after the course has been lightly rolled. Stone chips are then spread upon the surface and thoroughly rolled. After the surface is broomed, another coat of bituminous material is applied. The above method is also used when the road metal varies from one and one-half to two and one-half inches, in which case three-fourths inch stone is usually employed in place of chips.

Type C.—The foundation courses are filled to a certain extent with sand or small-sized broken stone, and, after the course is rolled, excess mineral matter is swept off. After the upper course of road metal is applied, its voids are filled to within about one inch of the surface and the bituminous material applied. The road is finished with a coat of sand or chips, which is rolled, although in some cases a second application of bituminous material and chips is used.

Type D.—A closely packed foundation or a concrete base is used, and large and uniform sized stone employed for the wearing course. In this method a layer of sand, three-fourths of an inch thick, is placed on the bottom course and bituminous material distributed, using about one gallon per square yard. The upper course of metalling is applied and the upper course thoroughly rolled, the bituminous mastic tending to fill the voids of the upper course. Another coat of bituminous material is applied and the surface finished by the application of a coat of chips, or two

applications of bituminous material are made, using, likewise, two coats of sand or chips.

Type E.—The upper course is constructed in the usual manner, and in place of sand or stone chips a bituminous mastic is applied to the surface, being rolled into the voids and forming the finishing surface of the road.

The remarks pertaining to distributing machines mentioned in connection with the discussion on bituminous surfaces apply with equal force to types of distributors used in the construction of bituminous pavements by penetration methods.

#### BITUMINOUS CONCRETE.

The construction of bituminous concrete pavements using broken stone in the aggregate has been developed along certain lines during 1911, although fear of litigation has restrained many engineers from advocating the use of this type of pavement. However, in contemplating the work which has been accomplished by the use of bituminous materials in this class of construction during 1911, it is evident that even the laity has appreciated the marked tendency to have faith that the courts of the United States, if necessity arises, will recognize that prior art and printed descriptions cover many satisfactory combinations of aggregates, which, when embodied in pavements, have inherent stability.

Bituminous concrete pavements, in the aggregate of which broken stone forms an integral part, may be divided into three groups, as follows, the classification being based upon the character of the mineral aggregate:

Type A.—One size crusher run stone; that is, any one product of a crushing plant.

Type B.—Combinations of one size crusher run stone and fine mineral matter, such as sand, stone screenings and fine gravel.

Type C.—Finely graded aggregates of broken stone and sand or other mineral matter.

Naturally Type A has been very popular, due to its inherent simplicity. During the year past the writer has seen excellent pavements constructed by this method where the aggregate was a one size crusher run stone having the following characteristics based upon a mechanical analysis: All the stone passed a one and a quarter inch sieve; not over 25 per cent. passed a one and a quarter inch sieve and was retained on a three-quarter inch sieve, and not over 5 per cent. passed a one-eighth inch sieve. Descriptions of old pavements of this type are legion. As an illustration may be cited the following specification used in England prior to 1899: "The hot stone, when ready for mixing, is screened into material of three sizes, one to two inches for the body, one-half to one inch for the intermediate coat, and one-quarter to one-half inch for the top dressing. The coarsest material is used in a layer three to four inches thick, the intermediate size forms a coat of about three-fourths of an inch, and the top dressing is used in the thinnest layer possible, with a view to filling all interstices. Afterward a dressing of quarter inch and smaller granite screenings is scattered broadcast, and the traffic at once allowed on the road to work this top dressing into the tarred material. Each of the layers is rolled separately with a ten-ton roller.

The State Board of Public Roads of Rhode Island has used Type A since 1906. It has been admitted in writing by certain patentees "that so long as the construction is of the nearly uniform sizes of stone which you are now using, and you do not get the fine material applied from the surface or into the spaces between the particles of bitumen-coated stone more than our observations indicate you are now doing, or we believe it is possible to do, we would not claim this feature of the construction to be an infringement of our patent No. 727,505." The construction referred to in the above quotation covers the construc-

tion of a wearing course of a bituminous concrete pavement under the following specification relative to the broken stone: "The bottom course shall consist of stone from one and one-quarter ( $1\frac{1}{4}$ ) inches to two and one-half ( $2\frac{1}{2}$ ) inches in their longest dimension, the upper course of stone from one-half ( $\frac{1}{2}$ ) to one and one-quarter ( $1\frac{1}{4}$ ) inches in their longest dimensions." Only the upper course stone was mixed with bituminous material. The product of the crusher which met this specification was obtained from the ordinary type of crushing plant, the broken stone usually passing a one and one-half inch screen and commercially being retained upon a three-fourths or five-eighths inch screen. A mechanical analysis of a typical product used in Rhode Island may be of interest, and hence is given below.

Per cent. passing 10 mesh sieve.....	1.0
" " $\frac{1}{4}$ inch sieve.....	2.5
" " $\frac{1}{2}$ " ".....	30.8
" " $\frac{3}{4}$ " ".....	34.2
" " 1 " ".....	23.4
" " $1\frac{1}{4}$ " ".....	8.1

As deputy engineer of the State Board of Public Roads of Rhode Island, the writer had charge of the construction and maintenance of bituminous surfaces and bituminous pavements for a number of years, and hence had the opportunity to inspect on numerous occasions the first section of bituminous concrete pavement constructed in 1906 under the above specification. This section has needed no repairs, although subjected to high speed motor car traffic of the heavy passenger type. Without doubt broad-minded judges would admit that this type of pavement has inherent stability.

The second type, that is, one having an aggregate composed of one size crusher run stone mixed with fine material, such as sand, screenings or material of a similar character, is likewise described many times in early technical literature. For example, the following description was published over thirty years ago: "The manner of preparing, treating and laying the asphalt mass is as follows: He took asphalt, 125 parts; petroleum oil, 25 parts. These substances were melted and thoroughly incorporated together, and to this mixture he added, in a heated state, sand or powdered stone, 750 parts, and gravel or broken stone, also heated, 1,100 parts. The whole was then thoroughly mixed."

During 1911 Type B was popular in various quarters. In Washington, D. C., under the jurisdiction of Captain Mark Brooks of the office of the Engineer-Commissioner, bituminous concrete pavements were constructed under the following specifications covering mineral aggregate: "The paving materials shall be composed of crushed trap rock screenings, concrete sand and mineral dust in the following proportions: Trap rock screenings, 2 parts; concrete sand, 1 part, and mineral dust, at least 5 per cent. of the above aggregate, mixed with asphaltic cement." The trap rock screenings referred to above varied in size from one inch to screenings, and were devoid of dust. Detailed specifications were also given with reference to the character of the sand and the mineral dust. The writer has had the good fortune to examine various streets paved under the above specifications. In his humble opinion these pavements possess inherent stability under commercial traffic.

In connection with the discussion of the use of the third type, that is, a graded aggregate of broken stone with or without sand and fine mineral matter, the consideration of the following description, so old as to be covered with the dust of decades, is apparently pertinent: "Broken stones are preferred for the whole pavement, and shall alone be used for the covering. The greatest dimension of stones for the base (except as hereinafter noted) shall be between three inches and one-fourth inch, and for the covering



between two inches and one-twentieth of an inch; the sizes shall be mixed in porportion, varying with the size to form a close mass, which, when dry and compact, can absorb not more than 20 per cent. of water."

During 1911 many thousands of yards of a pavement of Type C have been laid. In the Borough of Richmond, New York City, over 40,000 square yards were laid on a total of eighteen streets last year under the direction of Theodor S. Oxholm, M. Am. Soc. C. E. The mineral aggregate used conformed to the now famous Topeka specifications. A decree was signed by certain officials and representatives of certain patentees covering the use of the Topeka mineral aggregate. The following quotation is from the decree to which reference has been made:

It appearing to the court that of the mineral matter used in the pavements actually constructed in the cities of Topeka and Emporia, Kansas, no particles of stone were used that would not pass a screen with openings  $\frac{1}{2}$  inch in diameter, and that less than 10 per cent. of the stone or coarse sand used would be retained upon a screen with openings  $\frac{1}{4}$  inch in diameter, and the remaining mineral matter used being finer than  $\frac{1}{4}$  inch; and it further appearing that pavements constructed by the use of mineral particles as above described do not infringe the claims of complainant's patent No. 727,505, sued upon in this case. And it further appearing that the pavements as actually constructed in the cities of Topeka and Emporia, Kansas, do not infringe the claims of complainant's patent No. 727,505, sued upon in this case, and that any pavements hereafter constructed in substantial compliance with the following formula, to wit:

Bitumen .....	from 7 to 11%
Mineral aggregate passing 200-mesh screen from 5 " 11%	
" " " 40 " " 18 " 30%	

Mineral aggregate passing 10-mesh screen from 25 to 55%  
 " " " 4 " " 8 " 22%  
 " " " 2 " " less than 10%  
 sieves to be used in the order named, would not infringe the claims of said patent.

Mention should be made of the effect of the introduction of various types of low-priced mixing machines during 1911. The economical and satisfactory results accruing from the use of these machines for mixing certain types of aggregates with bituminous cements has caused the introduction of the mixing method in many localities where only the penetration method has formerly been used. During the season of 1912 many new machines of this type will be used, with the consequent increase in the construction of the various types of bituminous concrete pavements outlined above.

During 1911 considerable thought has been devoted to the methods and materials employed in the construction of sheet asphalt pavements. Notable work has been done by a special committee of the American Society of Municipal Improvements and the committee of the Association for Standardizing Paving Specifications. Throughout the United States there appears to be crystallizing a firm belief that specifications for materials should be opened to admit such asphalt cements as "Bermudez," "California," "Pioneer," "Texaco" and "Trinidad," for instance, which have shown by service tests that excellent pavements may be constructed by their use. This tendency is commendable, as thus competition is increased and the high quality of the asphalt cement is maintained.

## BITUMINOUS SURFACE TREATMENT

### Opinions of Many Experts Concerning the Use of Tar and Asphalt in Treating Road Surfaces—Methods and Costs—Selection of Material—Pressure Distributors for Bitumens

A DISCUSSION on this subject was held last winter by the American Society of Civil Engineers, at which much valuable information was contributed by experts, and in general they were all in practical agreement on all important points. An effort is made to give in the following a synopsis of the principal points brought out.

Under the heading of "Bituminous Surfaces" discussions were contributed by A. W. Dean, chief engineer of the Massachusetts Highway Commission; W. D. Uhler, second assistant engineer of the Maryland State Roads Commission; Arthur H. Blanchard, professor of highway engineering at Columbia University; Wm. H. Connell, deputy commissioner of public works of Bronx Borough, New York; Fred. E. Ellis, manager Essex Trap Rock and Construction Co.; P. P. Sharples, chief chemist Barrett Mfg. Co.; Clifford Richardson, consulting engineer; W. W. Crosby, chief engineer Maryland State Roads Commission; J. A. Johnston, division engineer Massachusetts Highway Commission; James Owen, county engineer Essex County, N. J.; C. J. Bennett, superintendent of streets, Hartford, Conn.; A. S. Brainard, highway engineer, and G. Immediato, town engineer, Montclair, N. J.

Concerning the selection of material, Mr. Dean said: "Experience has shown that while a heavy refined tar may be used to advantage on a macadam road, it is of no value as a surface application of an ordinary gravel or dirt road. For surface treatment of dirt roads, a light oil helps somewhat to preserve the road, in that it prevents the particles composing the surface from blowing away, and assists, to some light degree, in hardening the surface. For surface treatment of gravel roads the best results appear to be obtained by using an asphaltic oil of what might be termed medium viscosity, or by approximating the maximum vis-

cosity that will permit application through an ordinary distributor at a temperature of 50 degrees Fahr.

"For surface treatment of broken stone roads a light or medium oil acts mainly as a dust layer, yet if frequently applied it preserves the road to a very appreciable extent. In determining what bituminous material would be the most economical and advantageous for the preservation by surface treatment of broken stone roads, a knowledge of the traffic over the road is absolutely essential. If the road is subjected to light motor vehicle traffic and light team traffic, with the motor vehicles predominating, experience has shown that an asphaltic oil, of such viscosity that it requires heating to at least 250 degrees Fahr. before application, forms a bituminous surface which withstands the traffic and thoroughly preserves the road for a period of time depending partly on the quality of the material and workmanship and partly on the quantity of traffic.

"Residuum oils placed on roads in Massachusetts early in the season of 1909 still show life and an indication of durability for a considerable time to come, and this fact would show that, while natural asphalts may possibly be superior, the residuum asphalts are nevertheless suitable for the purpose.

"On roads where the prevailing traffic consists of steel-tired, horse-drawn vehicles, the application of bituminous surface consisting of heavy asphaltic oil and grit has proved unsuccessful in most instances, the surface being cut and dented to such a degree that it soon disappears. On such a road it is possible that a heavy, refined tar surface may be economical, or it may be economical to use oil of a lighter grade, applying it with sufficient frequency to keep the surface of the stone covered with oil at all times. The results in the surface treatment of such roads in Massa-

achusetts would indicate that bituminous surfaces are not economical where the prevailing traffic consists of horse-drawn vehicles, but that a more durable construction of the crust of the road must be made by either mixing or penetrating the upper course of stone with bituminous material."

Mr. Sharpless said on the same subject: "Several general principles may be deduced from the large number of experiments in New England. The heavy tars and asphalt oils are suitable as surface applications when the traffic is mainly automobiles, and give excellent results. When, however, to the automobile traffic is added a considerable amount of steel tire traffic, the conditions change, and if, as is the case in the centers of towns and in the suburban districts of cities, the steel tire traffic predominates, heavy bituminous surfaces are often failures. During the first rainy period the steel tire traffic and the horses' calks will probably cut up the surface, let the water into it, emulsify the bitumen, and produce a very disagreeable bituminous mud. It has been the speaker's experience that for such traffic conditions the thinnest possible treatments will give the best results. This is true of both tars and oils. In Hartford," said Mr. Bennett, "nearly all surface treatments with heavy asphaltic oils have been failures. The speaker thinks this is due to two things—the preponderance of horse-drawn vehicles on the city streets and the large quantity of clay soil which, in the fall, mixes with the oil and makes an emulsion resulting in a very disagreeable mud. This condition has obtained with the use of any asphalt oil, whether light or heavy, and whether applied under pressure or by gravity."

Concerning the methods of using the bituminous materials, Mr. Dean said:

"In the preparation of the broken stone surface extreme care should be taken to sweep and remove every particle of dust and dirt, so that the stones will be absolutely bare. Many failures of bituminous surfaces can be traced directly to the improper preparation of the broken stone surface, the heavy oils being distributed on dusty and dirty sections and consequently peeling up through lack of adhesion. In order to get the best adhesion of asphaltic oils, it appears that the stone surface should also be somewhat moist rather than extremely dry. In distributing the oil, if the stone surface is comparatively new and smooth, the best results appear to be obtained by applying the oil under pressure in two applications, each of  $\frac{1}{4}$  gal. per sq. yd., covering the first application with grit or pea stone before putting on the second, and covering the second application with the same material as soon as possible after it has been made. The effect of applying the material in this manner is to make the distribution more uniform and prevent surplus oil from flowing on the sloping crown of the road, thereby causing ridges and bunches to appear after the work has been done. If the stone surface is full of slight depressions, however, a single application of  $\frac{1}{2}$  gal. per sq. yd., applied with or without pressure, has proved satisfactory. The oil tends to run to the depressions, causing a slight surplus of oil in them, so that when the grit is applied on top of the oil the portions over the depressions absorb more grit, consequently rendering the road more smooth.

"The character of the grit or other material used for covering the oil is of great importance. Where the traffic is confined exclusively to motor vehicles, sand appears to be as effective as any material for covering, but if there is some steel-tired, horse-drawn traffic, a coarse material, like pea stone or fine gravel, is necessary."

Mr. Uhler states the following to be his conclusions from experience in treating more than 100 miles of macadam and gravel roads in Maryland with 12 kinds of bitumens:

"1. The road to be treated must be thoroughly swept before applying the bituminous material; otherwise the results will not be satisfactory.

"2. On a newly finished macadam road, about  $\frac{1}{2}$  gal. per sq. yd. will be necessary.

"3. In applying  $\frac{1}{2}$  gal. per sq. yd., it should be applied in two treatments of  $\frac{1}{4}$  gal. each, wherever practicable.

"4. After applying the bituminous material, sufficient time (from 12 to 24 hours) should be allowed, when possible, for it to penetrate, and the road should then be covered with a light application of coarse sand, pea gravel or granolithic chips. About 40 tons to the mile (14 feet wide) have been found to be sufficient in most cases.

"5. In view of the experience with gravity and pressure distributors as to results, time, etc., it is thought advisable, as well as economical, to use a motor truck fitted so as to apply the bituminous material under pressure."

Mr. Ellis "believes that a mistake is made by taking it for granted that a water-bound macadam road, constructed in the usual manner with a thin top course of small stone, is a proper surface on which to apply a bituminous coating. It is impractical to sweep the surface so as to make it entirely free from dust without at the same time making depressions where the small stones have been displaced by the broom. This is true where soft stone is used for the top course, and more especially where it is not uniform in character, as is generally the case when field stone is used. A comparatively thin top course composed of small stone is also objectionable for another reason. Vehicles traveling on a bituminous surface which is inclined to be sticky have a tendency to lift out the small stone, and in some places to tear up the top course for its full thickness. This causes the small holes so frequently seen in roads treated with a bituminous surface, which make such uncomfortable riding. If the dust or binder, either loose or compact, is not removed from the road previous to the application of the bituminous surface, the latter will push around on the road under traffic, and if it is not picked up by the wheels it will soon lose its life and leave the dry macadam unprotected. When the macadam surface is exposed the top course of the road disintegrates very rapidly, and, before the proper authorities are aware of it, the road is worn down to the bottom course.

"It has been the experience of the speaker, and of others who have tried it, that if the top course of a water-bound macadam road is constructed of stones which vary in size from  $1\frac{1}{4}$  to  $2\frac{1}{2}$  inches, with a depth of 4 inches after rolling, this layer being thoroughly filled with stone dust and flushed, such a surface will withstand traffic for a long time without raveling or breaking up. This surface can be swept clean without disturbing in any way the stones composing it, because they are large and are firmly embedded. There is also very little danger of the stones being lifted out by wheels sticking to the bituminous material.

"The cover for bituminous materials should be composed of broken stone screenings or gravel which will pass through a screen with a mesh of about the size of the thickness of the bituminous carpet required. This is necessary so that the weight of the traffic will be transmitted to the macadam by the stone composing the cover rather than through the plastic bituminous material itself. If the cover is composed of too fine material, without a mixture of a sufficient quantity of coarser particles, the surface will become rutted, the carpet rolling out very thin where the wheels run and increasing in thickness on each side where the traffic is not heavy. The bituminous material should be applied uniformly and in such quantity as will not cause the material to flow toward the shoulders of the road. This can be done best by a machine which applies the material under pressure. Where the bituminous material is applied in such quantity that it flows toward the shoulders, the surface will be wavy, because that part of the roadway where the flowing occurs will take up more of the covering material than where the flowing does not take place, thus giving a thicker carpet in some places than in others."



"These remarks do not refer to the application of the purely dust-laying oils. If they are to be used the surface should not be swept so as to expose the stone, as by so doing the oil will lubricate the stone and the road will ravel."

Mr. Johnston "believes that in applying a bituminous surface treatment to a newly built macadam road it is best to scarify the surface, but if stone of large size (from 1½ to 2½ inches in longest dimensions) is used on the surface, it may be possible to sweep the road so clean that, without scarifying, a good adhesion or bond can be secured."

Mr. Brainard said: "The maintenance of the State macadam roads in Connecticut is accomplished by first applying a coat of Glutrin. After this has been allowed to season somewhat a light coat of asphaltic oil is applied over the surface, which is then covered with sand or light gravel to prevent tracking. \* \* \* This method allows the aggregate to cement of its own natural ability and at the same time protects the road from the lubricating action of the oil when it is applied, which is said to cause the road to ravel and disintegrate."

Mention is made in several of the above quotations of distributing machines. Concerning these Mr. Blanchard said that more than fifteen kinds had been placed on the market during 1911, each more or less suitable for distributing one or more kinds of materials. "There are, however, some well-known general limitations; for instance, it has been found extremely difficult with a gravity machine to distribute uniformly less than 0.4 gal. per sq. yd. with certain grades of material, unless the material is brushed into the road, with brushes attached to the machine or in the hands of workmen. With some of the pressure machines, however, it is possible to obtain a uniform application with certain kinds of materials in quantities as small as 0.1 gal. per sq. yd. On the other hand, it has been found uneconomical to apply, with any of the 1911 pressure distributors, certain grades of asphalt suitable for the construction of bituminous macadam pavements or for the application of some asphalts, solid at air temperature, used for seal coats on bituminous concrete pavements."

"The hand-drawn gravity distributor will probably prove more economical and efficacious for the application of seal coats on bituminous concrete pavements than any other type of distributor. Since the seal coat is applied to the wearing surface as soon as a stretch of the latter is ready to receive it, the amount of work to be done in any one day is small and would not usually warrant the use of a distributor of large capacity."

Mr. Connell stated that in the Borough of the Bronx, New York, preparations are now under way to equip the Bituminous Application Division with a sufficient number of pressure distributors to do all the bituminous surface work in 1912. For the cold treatments the distributing device can be attached to an ordinary water sprinkler. The heavier materials will require the use of heater wagons. Considerable stress has been laid on this method of application, because, in the writer's opinion, it results in saving not only labor, but also bituminous material, as the latter is applied to the road in such a manner that there is little chance of it being washed away.

"The pressure machine," said Mr. Crosby, "seems to act like the cement gun when used on dirty steel, because the sand blown through the gun against the steel cleans off the dirt and allows a good adhesion of the cement. In the same way the pressure distributor seems to obliterate the dust film between the stone or concrete and the pitch, which nullifies the adhesiveness of the latter; at least, where it has often been difficult to obtain adhesiveness under a gravity application, the results have been entirely satisfactory where the same materials have been applied under pressure."

The Massachusetts use of the pressure machine was described by Mr. Johnston as follows:

"In Massachusetts for three seasons excellent results have been obtained by spraying bituminous materials with a pressure of not less than 70 lbs. per sq. in., and in light coatings of ¼ gal. per sq. yd. With the nozzle used for this purpose the pressure is not lost, for the bitumen strikes the road with such force that dust, leaves, or scraps are blown ahead of the machine and out of the way of the spray. This high pressure dislodges the dust and fine particles, forcing the bitumen into every crevice and cranny of the road, adhering to and gripping the rough surfaces of the stone, resulting in a thorough bond."

"It is conceded that gravity applications are not satisfactory and that pressure is essential. Pressure below 50 lbs. will neither dislodge the dust sufficiently to permit of proper penetration and adhesion, nor spray the light coats (of ¼ gal. or less) as uniformly as can be done with the greater force, and it has been the speaker's practice to use not less than 70 lbs."

Among other points brought out by the discussion were the following:

By Mr. Sharples: "Another point in regard to these surface treatments which has not been brought out is the grade and shape of the roadway before treatment. The bituminous treatments in every case make a more slippery surface than the original bare macadam roadway, and in planning for a surface treatment this must be kept in mind. For any road having a bituminous surface it is very important to reduce the camber or side slope to a minimum. A horse, in slipping, does not mind a forward or backward slip very much, but, if he slips sideways he falls."

By Mr. Richardson: "It may be of interest to explain why an application of oil to the surface of a macadam road after it has been watered may act better than on a dry road. There is always a slight coating of dust adhering to the surface stone, which prevents adhesion. If, however, the surface is sprinkled before the application of the oil it converts this dust into a paste. The dust is the detritus of the rock, and, like clay, it is more or less colloidal. The result is that the dust in this condition will emulsify with the oil when the latter is applied to the surface and will mix with it so readily that the bitumen will come in contact with the rock, and, after the evaporation of the water, will adhere perfectly. Clay and water will mix with any kind of asphaltic oil, and with the greatest facility. A great deal of it has been used on roads in Germany for distributing oil as an emulsion. The clay and water are mixed with the oil, put into the watering cart, and sprayed on the road."

By Mr. Crosby: "Some bituminous materials which the speaker has used for surface treatments have caused a disagreeable mud in the wet season. This mud seems to be due to the formation of an emulsion of the oil and water by the aid of the fine material, such as the finely divided clay from the shoulders or from cross roads brought on the treated road. Some years ago the speaker used considerable light oil for surface treatment, with the result that in almost every case the disagreeable mud complained of occurred during wet weather. Slight differences in the quantity or character of the mud led him to believe that possibly its formation was affected, not only by the traffic, but also by the character of the soil adjacent to the road in question."

Among the cost data contributed, the following were the principal:

By Mr. Dean: "In Massachusetts during the last four years several hundred miles of macadam roads have been improved or preserved by a bituminous surface of this kind. The average cost during 1910 was a little less than \$0.08 per sq. yd., and, during 1911, a little more than that price, with labor costing from \$1.75 to \$2 per 8-hour day, and asphaltic oil costing \$0.06 per gal. delivered in tank cars. The detailed cost on an average road is as follows:

	Per square Yard.
Cleaning and sweeping.....	\$0.0056
Patching old surface .....	0.0016
Cost of oil .....	0.0319
Heating oil .....	0.0031
Delivering oil .....	0.0038
Distributing oil .....	0.0029
Furnishing sand beside road .....	0.0165
Spreading sand .....	0.0073
Watering .....	0.0012
Rolling .....	0.0002
Supervision .....	0.0025
Total .....	\$0.0766

"The road mentioned was treated with  $\frac{1}{2}$  gal. of heavy asphaltic oil in two  $\frac{1}{4}$ -gal. applications. The average haul was 2 miles for the oil and  $2\frac{1}{2}$  miles for the sand. No allowance is made in the foregoing detailed statement for rental or depreciation of machinery, or for profits to contractor, the work being done by labor force account.

"In maintaining these bituminous surfaces a retreatment of about  $\frac{1}{4}$  gal. of bituminous material per square yard is only made on those places from which the bituminous material has disappeared. To show the probabilities of the cost of maintenance of roads by applying bituminous surfaces thereon, the speaker might cite 18 miles of State highway constructed in 9 towns in Massachusetts in 1909, the bituminous surface consisting of  $\frac{1}{2}$  gal. of residuum asphaltic oil. The first cost of the bituminous surfaces on these roads in 1909 averaged \$0.0742 per sq. yd. In 1910 there was expended for patching and sanding \$0.0146, and in 1911, \$0.0088 per sq. yd. The present condition of these roads indicates that the expense for patching and sanding in 1912 will not exceed \$0.01 per sq. yd., in which case the total expense of maintenance of the surfaces on these roads for four years will have been \$0.1076, making the cost \$0.0269 per sq. yd., or approximately \$236.72 per mile per year for a 15-foot road, which cost does not exceed that of maintaining similarly located macadam roads previous to the advent of motor vehicles."

Concerning costs in Maryland, Mr. Uhler said: "The cost of these surface applications varied from 1.8 cents to 8.93 cents per sq. yd., or from \$148 to \$734 per mile; the cost of bituminous material varied from 3.75 cents to 9.1 cents per gal. f. o. b. at the point of delivery; grit for the top dressing cost from 0.33 cent to 3.5 cents per sq. yd. in place, depending on its character and location. With the exception of 16 miles on which the bituminous material was applied under pressure, it was all applied with gravity oilers. While varying conditions will affect the figures slightly, a fair average of the detailed costs is as follows:

	Per square yard.
Sweeping .....	\$0.0015
Pitch (delivered) .....	0.0300
Applying pitch .....	0.0045
Grit (delivered) .....	0.0030
Applying grit .....	0.0010
Total .....	\$0.04

"The experience of 1910 in the Borough of the Bronx," said Mr. Connell, "having proved that bituminous surface applications were more efficacious and economical than water sprinkling on macadam and earth roads, the water sprinkling division has been abolished, and all the macadam and a number of earth roads have received a surface treatment of tar or asphalt road oil. The results from tar have been very satisfactory, about  $\frac{1}{3}$  or  $\frac{1}{2}$  gal. per sq. yd. being applied and covered with torpedo sand or fine wash gravel. This formed a very desirable surface at a cost of \$0.035 for  $\frac{1}{3}$  gal. and \$0.045 for  $\frac{1}{2}$  gal. per sq. yd. In these treatments the tar was applied cold.

"The Grand Boulevard and Concourse was treated with a heavier tar, which was applied under pressure through a hose at a temperature of 220 deg. Fahr.,  $\frac{3}{5}$  gal. per sq. yd. being used, and then covered with torpedo sand or

fine wash gravel. This road has been in use for 6 months, and although it has been subjected to very heavy, high-speed automobile traffic, it is now in first-class condition. The cost was \$0.138 per sq. yd., which is high, owing to the lack of proper facilities for handling the bituminous material and the numerous delays which occurred. In the Borough of the Bronx a fair cost would be from \$0.09 to \$0.10 per sq. yd. for this treatment. Before the application of tar in these treatments the road was thoroughly swept with horse-drawn and hand brooms.

"Asphalt road oil of about 20 deg. Baumé gravity was applied to a number of macadam roads, using  $\frac{1}{4}$  gal. per sq. yd. On roadways having light or medium traffic one application a year was sufficient to keep the road dustless; heavily traveled roadways required two, and in some instances three applications. The cost of this treatment was \$0.013 per sq. yd. when  $\frac{1}{4}$  gal. per sq. yd. was used. The oil was applied with a pressure distributor on a number of roadways, and the cost was \$0.009 for  $\frac{1}{5}$  gal. per sq. yd. This method of treatment is both economical and desirable. Just enough pressure was applied (about 15 lbs.) to drive the oil into the interstices of the stone to a sufficient depth to avoid having a mushy road surface. Before the application of the asphalt road oil, the surface was swept with a horsedrawn sweeper only.

"The following table gives a comparison of the cost of surface treatments and water sprinkling in the Borough of the Bronx, the water sprinkling being based on sprinkling from three to four times a day for 180 days, at \$5 per day for a team, and water at \$0.10 per 100 cu ft.

Tar, 1-3 gal. per sq. yd.....	\$0.035
Tar, $\frac{1}{2}$ gal. per sq. yd.....	0.045
Asphalt road oil, about 20° Baumé gravity, $\frac{1}{4}$ gal. per sq. yd.....	0.013
Two applications .....	0.026
Asphalt road oil, about 20° Baumé gravity, pressure distributor, 2-10 gal. per sq. yd..	0.009
Two applications .....	0.018
Water sprinkling .....	0.051

"In order to compare these costs with those of other localities, the following figures relating to materials and wages paid to laborers and foremen in the Borough of the Bronx are submitted:

Foremen, per day .....	\$4.00
Laborers, per day.....	2.25
Average price of tar at freight yard, per gal.	0.061
Average price of asphalt road oil at freight yard, per gal.....	0.04
Torpedo sand, on the work, but not spread, per cu. yd. ....	1.30

"With the use of pressure distributors in 1912 the cost of applying the tar will be greatly reduced. The present method requires the services of three laborers, whereas a distributor will need only one man to operate it, and moreover the time required to apply the tar will be reduced to a minimum."

Concerning the effect of the season when the work is done, A. F. Armstrong said: "The New York State Highway Department built about 1,300 miles of bituminous macadam highways by the penetration method during 1909, 1910 and 1911.

"There have been some failures, but they have been few. The writer estimates them as less than 1% of the mileage of the highways built. They were due principally to pouring too late in the season; poor workmanship; wet or dirty stone; brittleness in the bituminous material, and poor foundation. A trap rock road is naturally the hardest to bind, and raveling occurs more frequently on those built with this material than on those where other kinds of stone have been used. It is believed to be of the greatest importance that bituminous macadam, made by the penetration method, should be laid early enough in the season, to have traffic over the road for at least one month of warm weather, so that it may be thoroughly compacted before cold weather arrives to harden the bituminous material."



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MAY 16, 1912.

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## Function of Bitumens in Road Treatment

DURING the past few months we have been impressed with the number of times which the statement has been made by both city engineers and highway superintendents that it is worse than useless to expect bituminous materials applied to road metal to serve to any extent as a binder of the body of the road surface, but that the function of this material is to hold together and onto the body of the road the finer surface particles, and secondarily, to provide a water-proofing coating to the road. For instance, in using rounded gravel, which, without the use of bituminous material, would not have sufficient inherent stability when rolled like a macadam pavement to serve as a road surface, success cannot be expected with the addition merely of an asphaltic binder. If the bitumen is so soft that it will not become hard and friable in cold weather and after compression under traffic, it will be so flexible that it will not

hold the gravel stones firmly in place, but the pavement will creep and rut under traffic.

This theory, if correct, means that the metal chosen for all but the surface wearing carpet of any road should be practically the same whether or not bitumen is used in the construction, and that then there should not be added enough of the bituminous material in the body of the road to prevent the stone particles from locking and bonding together.

## Road Foundations

At a conference of highway superintendents and engineers held last winter one point discussed upon which all seemed to agree was the great importance of properly draining the foundations of roadway pavements and compacting the sub-grade; and there also seemed to be no dissent from the statements made that the former, and in many cases the latter also, are quite generally neglected in the majority of cases. No wearing surface is or should be expected to be capable of preventing distortion of the pavement under load, but the function of this should be to present a smooth surface and resist abrasion, suction of automobiles, the pounding of horses hoofs, etc. Materials which successfully meet these conditions are never, it is believed, the best for supporting loads, but a separate foundation construction should be supplied for this purpose. In some cases the natural soil suffices for this where the loads are not particularly heavy; but there are probably few, if any soils, which can successfully withstand for long the loads imposed by heavy touring cars and the even heavier automobile trucks which are now being found on all improved highways.

It is, of course, possible to provide a reinforced concrete foundation which would be amply strong to carry the heaviest traffic over soft, undrained soils; but this would be prohibitively expensive even for city streets, and would be utterly out of the question for suburban or country highways. Advantage therefore must be taken of all the support which the natural soil or sub-grade is able to furnish, thus permitting the thickness and cost of the foundation to be reduced proportionately. This means that wherever there is any possibility of water getting at the soil from the sides or beneath, or where the top coating is not impervious and the soil will not naturally and rapidly drain away any moisture which may reach it from above, drainage should be provided.

The tendency in constructing bituminous treated road surfaces is to make these flatter than the old style macadam, both because the surface water will drain off from these with a less crown than is necessary for water-bound macadam, and also because the bituminous surfaces are more slippery and too great a crowning makes them dangerous. This means that not only the surface but also the sub-grade is given much flatter side slopes, and therefore reliance cannot be placed on this slope for carrying to the sides of the roadway over the surface of the sub-grade any water which may reach it from above.

Reports from a number of states indicate that an increasing number of roads are found to be going to pieces because of rutting or distortion of the pavement under heavy loads; and this is the most serious condition which road maintenance departments have to meet, since it means that mere surface treatment will be of little avail in preventing its continuance. It seems imperative, therefore, that road builders should apply more generally in their practise what they all admit to be theoretically correct—the principle that the sub-soil should be kept absolutely dry where it is of a clayey or loamy nature, and that more or less elaborate artificial sub-drainage is absolutely essential wherever the topographical or geological conditions are such as to cause any considerable amount of moisture to reach the sub-grade at any season of the year.

The matter of rolling is of less importance than drainage,

since if the latter is provided the road surface will generally in time reach a state of stability, even should it yield somewhat and cause minor deformations in the surface during the first season or two of operation; which minor deformations can be remedied by surface repairs. But this surface deformation makes an undesirable road until it is repaired, the repairs add more or less unnecessary expense to the maintenance, and if not attended to promptly may mean the rapid destruction of the road. This could generally be prevented by a thorough compacting of the subgrade by rolling. Certain engineers have stated that they have found too much rolling to be an actual disadvantage in some cases, there being a certain class of clayey soils which, although fairly firm before rolling, become putty-like in their nature after a ten-ton roller has passed over them two or three times; and that for such soils the best treatment is passing a five-ton roller once or twice only, to merely compact any loosening of the surface caused during excavation and iron out irregularities. But whatever the exact treatment required to compact the sub-soil, this will save much future trouble and expense in maintenance, and generally insure a better road than would be possible without it.

### STATE AID

In our issue of May 17, 1911, we gave information concerning the amount of State aid given to highway construction in the several States of the country, together with the commission or other body through which this aid was extended. At that time several of the States gave no financial assistance and exercised no control over the highways within their boundaries, these States being Alabama, Arkansas, Florida, Georgia, Idaho, Indiana, Kentucky, Mississippi, Montana, Nebraska, North Carolina, North Dakota, Oklahoma, Oregon, South Carolina, South Dakota, Tennessee, Texas and Wisconsin. In Delaware highway engineers are furnished by the State for two of the three counties. During the past year several of these States have been added to the list of those which give aid or exert control over the highways. Alabama had at the time of the issue referred to passed a bill providing for a State Highway Commission and this has been appointed and an appropriation of \$154,000 annually out of the convict fund has been provided for. Arizona gives State aid and advice, the former limited principally to convict labor, through a commission composed of the Governor and Auditor ex officio, and a private citizen. California has transferred the charge of the highways from the State Engineering Department to a State Highway Commission composed of three citizens. Idaho passed a good roads law in 1909, which was declared to be unconstitutional, and a new law was passed last year providing for a State Highway Commission composed of the Governor, State Engineer and State Mining Inspector, ex officio. In West Virginia the office of State Commissioner of Public Roads was abolished in 1911, and there is now no State supervision. In Wisconsin a sort of oversight of the road work had been carried on by a Highway Division of the State Geological and Natural History Survey; but in 1911 a State Highway Commission was appointed consisting of the State geologist and a professor of the State university, ex officio, and three citizens, and State aid provided for amounting to \$350,000 a year.

Five of the States have made service on the State Highway Commission as one of the duties of certain of the professors in the State colleges. Thirteen States pay no salaries to the commissioners and sixteen States do pay salaries. Michigan is the only State in which the commissioners are elected, they being appointed in all the others, or else being State officers or college professors acting ex officio. Eight of the States have only a single commissioner on salary.

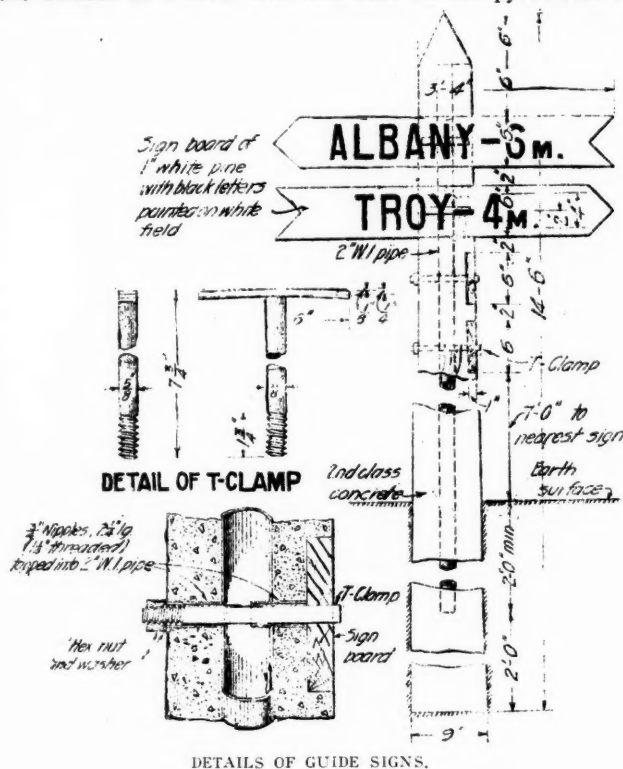
## NEW YORK HIGHWAY DETAILS

### Constructing Guide Sign Posts, Mile Posts and Guard Rails of Concrete—Wooden Guard Rails—Construction Details

THE Department of Highways of the State of New York has adopted a number of standard designs for structures for use on the State and county highways during the year 1912, these including culverts, inlets, ditch crossings, retaining walls, etc., as well as sections of roadways. The standard crown adopted for a 14 or 16-foot paved strip is  $\frac{1}{4}$  inch per foot for bituminous, Hassam, bituminous mixed, bituminous macadam and brick pavement, and for regular water bound macadam a crown of  $\frac{1}{2}$  inch per foot.

Provision is made for the use of concrete extensively not only in pavement foundations, culverts and other underground structures, but for fences, mile posts and other accessories. The concrete mile post is made with its cross section an isosceles triangle with rounded corners, the base (the side away from the road) being 6 inches and the height at right angles to this 12 inches. The post is buried 3 feet 6 inches in the ground and extends 2 feet 6 inches above the surface. Two vertical rods having a cross-section area of  $\frac{1}{4}$  square inch are used for reinforcement. Names and distances are added by pressing patterns of letters and figures into the concrete while soft and filling in the depressions with black cement.

Guide signs are made as shown in the accompanying cut. The post is made square in section, 9 inches on a side at the bottom and 6 inches at the top, the top 6 inches of the post being pyramidal in shape. From a point 2 feet above the bottom to a level with the base of the pyramidal top



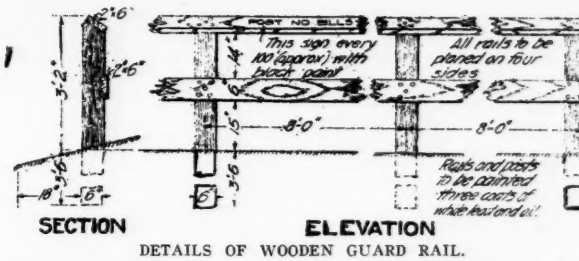
DETAILS OF GUIDE SIGNS.

extends a 2-inch wrought iron pipe through the center of the post to serve as a reinforcement. The post is made 14 feet 6 inches high from base to extreme top, at least 4 feet being buried in the ground. For fastening the sign boards to the post a groove 1 inch deep and 6 inches high is made in one face of the post, and from the middle of this a hole is made through the post in which is inserted a  $\frac{3}{4}$ -inch wrought iron nipple through which to pass a  $\frac{5}{8}$ -inch bolt, which holds the sign board in place. The sign board, of 1-inch white pine, carrying black letters on a



white field, is attached by placing it in the groove so that its face is flush with the face of the post, and passing through the hole in the post and a corresponding one in the board a clamp as shown in the illustration, which is held by a nut at the back of the post. Provision is ordinarily made for four signs, two on each of two sides of the post, and the lowest of these is placed at least 7 feet above the surface of the ground.

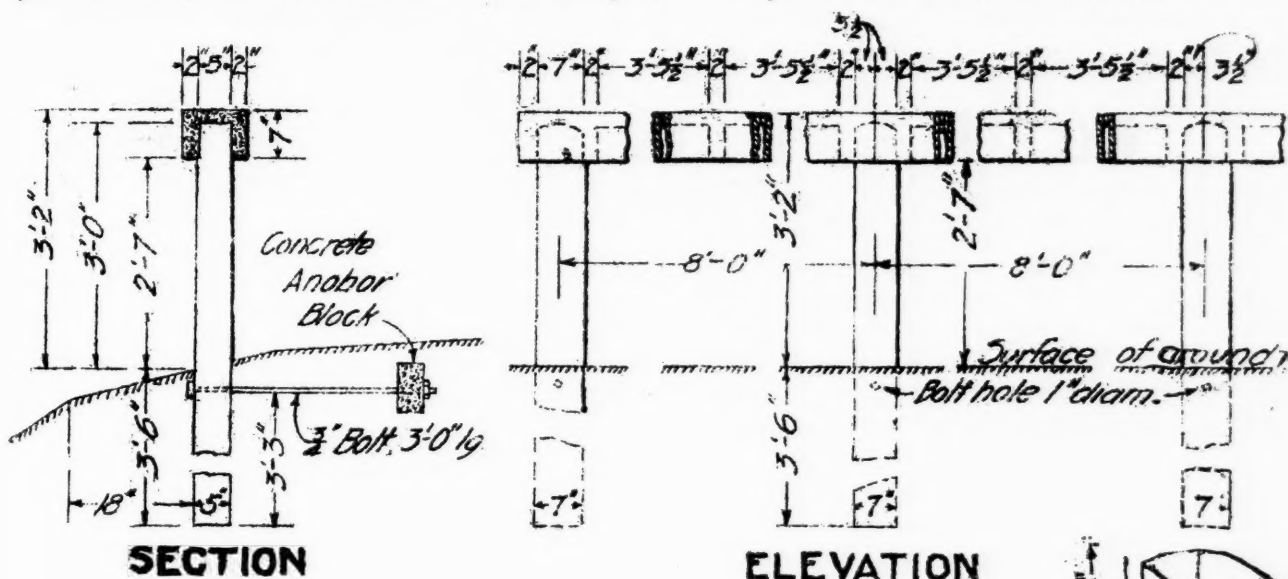
Concrete is also used for the construction of guard rails along embankments or other dangerous places. These consist of a series of posts set 6 feet between centers and carrying on their upper ends a reinforced concrete rail whose upper surface is 3 feet 2 inches above the ground. Each post is anchored by a  $\frac{3}{4}$ -inch bolt 3 feet long to a concrete anchor block buried in the ground nearer the center of the roadway. The posts are made of uniform cross-section, 5 inches by 7 inches and 6 feet 6 inches high. Each contains a  $\frac{3}{8}$ -inch steel bar near each corner for reinforcement. The top 5 inches is  $1\frac{1}{2}$  inches smaller each way than the remainder of the post, thus leaving a  $\frac{3}{4}$ -inch shoulder on each side. The rail is practically a channel of reinforced concrete, the opposite sides being connected by 2-inch cross webs so placed that a pair will occur at each post, leaving a mortis space which will just fit over the top of the post and come down to the shoulder just mentioned; and also another cross web half way be-



DETAILS OF WOODEN GUARD RAIL.

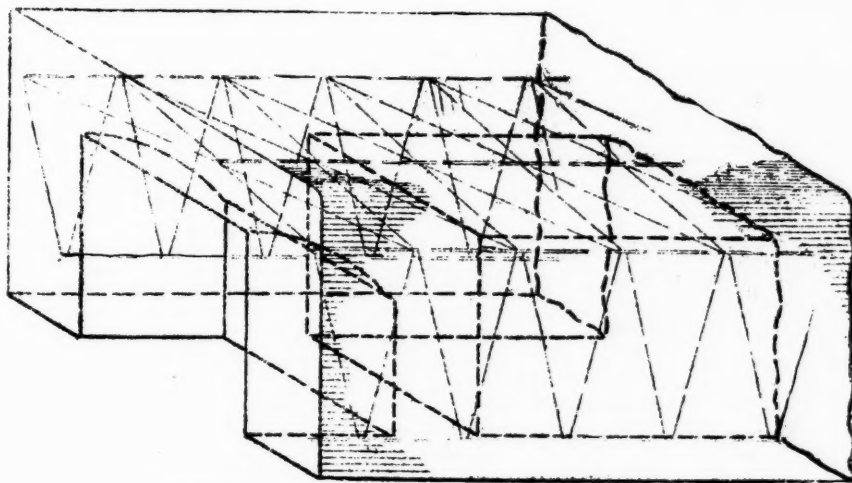
tween each pair of posts. The posts are embedded with their bottom 3 feet 6 inches below the surface. The anchor bolt is placed 3 inches below the surface.

Where wooden guard rails are used these are made with 6 x 6-inch posts spaced 8 feet between centers and set with their bottoms 3 feet 6 inches below the surface, and so that the top of the top rail comes 3 feet 2 inches above the surface. The top of the post is cut at an angle of about 30 degrees with the horizontal, the slope being toward the road, and on this is nailed a 2 x 6-inch top rail. Another 2 x 6-inch rail is nailed to the inner face of the post so as to leave 14 inches clearance between the two rails. All rails are planed on all four sides and these and the posts are painted with three coats of white lead and oil. The sign "Post no bills" is painted on top of the top rail with black paint at intervals of about 100 feet.



SECTION

ELEVATION



SKETCH OF PORTION OF RAIL

SHOWING TRIANGLE MESH CONCRETE REINFORCEMENT No. 3  
WT. 15# PER SQ. FT. OR ITS EQUIVALENT

DETAILS OF CONCRETE-STEEL GUARD RAIL.



DETAIL OF POST  
SHOWING TOP AND  
REINFORCEMENT

## HIGHWAY CULVERTS AND BRIDGES

Foundations—Appliances for Testing Soil—Box Culverts—Long Span Culverts—Model Plan Giving Details—Reinforced Slabs—T Beam and I Beam Construction—Abutments and Wing Walls

Abstract of a Bulletin of the Office of Public Roads of the U. S. Department of Agriculture

THE method of inviting bids for bridges upon the bidders' own plans, without having a competent and disinterested engineer pass upon the design submitted, has been more or less common in highway work but has proved almost always objectionable and sometimes disastrous. The desire to secure a contract encourages unscrupulous bidders to put in too small an amount of steel and scrim in the shop work necessary for good strong connections, resulting in a bridge with too low a factor of safety for the load which it is designed to carry. The plan to be observed in obtaining a bridge should consist of steps such as the following:

1. The services of a competent bridge engineer should be secured.

2. The foundation should be tested to determine its suitability, bearing power and economy.

3. The location should be determined within a close approximation, and a profile of the center line made, showing also the results obtained by testing the foundation.

4. The loads which the bridge may be called upon to carry safely, anticipating reasonably the demands and growth of the future, should be decided upon. All highway bridges, at least those on main roads, should be designed to carry concentrated loads such as road rollers or traction engines weighing from ten to fifteen tons each, with a reasonable factor of safety. Unfortunately for the traffic of to-day, many of the present highway bridges were designed to carry only moderate uniform loads, and this accounts for their light appearance and their inadequacy to meet present demands.

5. After these facts have been determined, the engineer will be able to prepare plans for the foundations, abutments, piers and the bridge itself, all of which may be designed to meet economically the conditions of the location selected. An estimate of the cost may be made, and this should in all cases be used as the basis for an appropriation for the bridge.

In the case of small culverts the method of procedure need not be as complete as this. The Office of Public Roads has prepared a set of standard designs for culverts varying from 2 feet to 30 feet, which will satisfactorily meet most conditions.

### FOUNDATIONS.

Taking up first the subject of foundations, it is stated that an ordinary earth foundation is sufficient in most cases for box culverts from 2 to 8-foot spans carrying only ordinary loads, if proper precautions be taken against undermining by currents of water. Where the streams are sluggish or the culverts are located on soft and wet ground, a few logs 10 or 12 inches in diameter, placed transversely of the culvert and upon which the footings rest, add much to the stability of the foundation. The logs may be placed

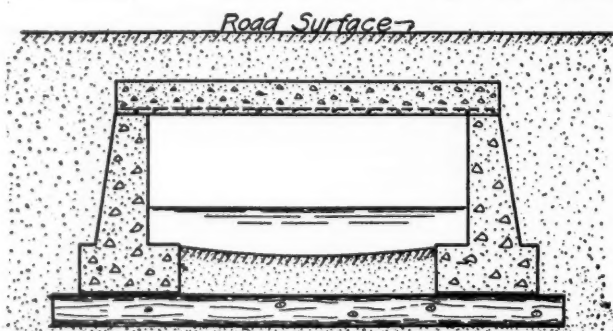


FIG. 1.—CULVERT WITH LOGS IN FOUNDATION.

close together or in many cases it will be sufficient to place them 3 feet apart between centers. These logs distribute the pressure and tend to prevent uneven settlement or tipping of the side walls.

For more important structures the foundation should be carefully tested. This can be done best by digging test pits wherever conditions will permit, since in this way a better idea can be gained of the actual material in the sub-soil than by any other method. Where test pits are not practicable an iron rod may be driven to rock if this oc-

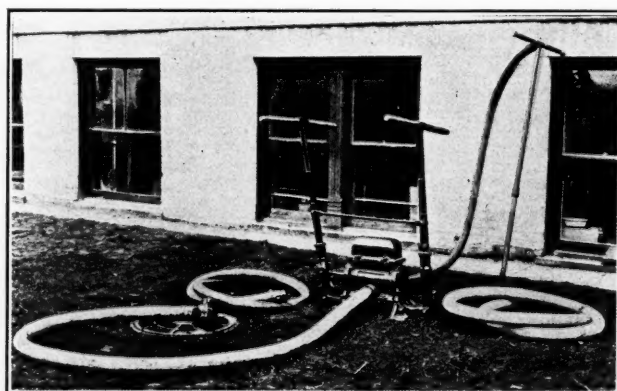


FIG. 2.—WASH DRILL OUTFIT FOR TESTING FOUNDATIONS.

curs within a depth of 10 to 20 feet. This method, however, while it gives the depth of rock gives very little idea of the material through which the rod is driven; and a large boulder may be mistaken for ledge rock.

A somewhat better way is to drive down one-inch extra heavy iron pipe which has been cut into 4-foot lengths which may be coupled on successively as the pipe is driven. A driving cap should be used on the top length and the driving should be done with wooden mauls. Pipe has been driven in this manner to depths of 30 feet or possibly more. It may be pulled out with a small chain and lever, bringing up inside of it a sample of the material through which the pipe is driven. The lengths are then uncoupled and the material removed from them for examination. Material that sticks in the pipe may be loosened by placing the 4-foot section in a small fire sufficient to generate steam from the moisture in the material, which, as it expands, forces the material out of the pipe. The fire should not be too hot for if the steam is generated quickly the material may be shot out of the pipe or the pipe itself burst and injure those standing near.

One of the best ways to test a foundation is with a wash-drill outfit, consisting of a drill point to which is coupled 1-inch iron pipe in 4-foot lengths. Water is forced through this pipe by a double-acting force pump operated by one or two men. Tests have been made with such an outfit to depths as great as 60 feet. The wash-drill may be used with or without a jacket pipe. If a jacket pipe is used, it should consist of light weight iron pipe about 3 inches on the inside diameter, cut into 4-foot lengths, which may be coupled on as the pipe sinks into the ground. The benefit of the jacket pipe is that it preserves the boring for future use and that the material inside the pipe is washed up to the surface so that it may be examined.

Figure 2 shows a wash-drill outfit owned by the Office of Public Roads, which has been supplied to the office for its own work, and which consists of a double-acting force



pump, with a cylinder 5 inches in diameter, a 5-inch stroke, a 2-inch suction, and a 1½-inch discharge. The pump is fitted with two 12-foot lengths of suction hose with a strainer, two 12-foot lengths of pressure hose, twelve 4-foot lengths of 1-inch extra heavy iron pipe, and a drill point.

The kind of material in the foundation determines to some extent the size of the footings for the structure, with due consideration to the weight to be borne and the bearing power per square foot of the material. Rock makes the best foundation and should be used when it occurs at available elevations.

A great many tests have been made to determine the bearing power of other materials, and, while there is much variation in results, the following figures are given as indicating the range of values obtained and, in the absence of more definite information, they may be used as allowable working loads:

Material.	Bearing power (tons per sq. ft.)
Quick sand and wet soils.....	.05 to 1.0
Dry earth .....	1 to 1.5
Moderately dry clay .....	2 to 4
Dry, stiff clay .....	4 to 6
Sand .....	2 to 4
Sand, compact and cemented.....	4 to 6
Gravel, cemented .....	8 to 10
Rock .....	200

Arches used for bridges or culverts require an especially unyielding foundation and are more than likely to fail unless such is provided. Consequently they should not be built except where a good rock or gravel foundation is to be had or possibly where a satisfactory foundation can be made by driving piles.

Where sufficiently firm foundation of rock or natural soil cannot be obtained, piles may be used. For culverts and other small structures the bearing power of the piles may be calculated by the formula

$$\text{Safe load} = \frac{2 WH}{S + 1}$$

Where W is the weight of the hammer (in the same unit as the safe load), H is its fall in feet and S is the penetration in inches under the last blow. In bridge construction, and especially in arch construction, actual tests of the bear-



FIG. 4.—CONCRETE SLAB CULVERT ON A MASSACHUSETTS STATE HIGHWAY.

ing power or other method of more accurately determining the safe load should be employed.

If a test of the foundation at the site determined upon shows that suitably firm material is not available or is found at too great depth for economy, it may be more economical, or even necessary, to shift the location of the bridge, even though it involves a relocation of the road for a short distance each way. A bridge or culvert should be built in the direct line of the road, whether this is at right angles to the stream or not. There are probably no conditions under which this construction is impossible or even particularly difficult, and the sharp, dangerous reversed curve in the road caused by a bridge making an angle with its general direction is most seriously objectionable.

#### CULVERTS.

Culverts of whatever construction consist of a top, either flat or arched; side walls with their footings, and foundations where necessary, and a floor or lining to the bottom of the water channel. There should also be provided wing walls at the upper or entrance end, and in the majority of cases where rock is not found on the surface, cut-off walls across the line of the channel at the upper end and frequently at the lower end also. Footings for abutments and wing walls may be required for distributing the pressure of

the completed culvert and the load carried by it over a sufficient area to keep the pressure per square foot within the amount which the material composing the foundation will carry with safety. In some cases where the wall is thick and rests upon a rock foundation no footings will be required. If the wall is of the reinforced concrete type, footings are practically always necessary. Many wing walls have been broken because suitable footings had not been placed under them.

The width of the footing is determined from the load to be carried and the bearing power per square foot of the foundation material. Its depth is determined from its width and the load carried. If constructed of plain concrete or masonry its depth should be equal to the projection from the pier or wall, or even greater; it being practicable, however, to reduce the depth somewhat by the use of steel

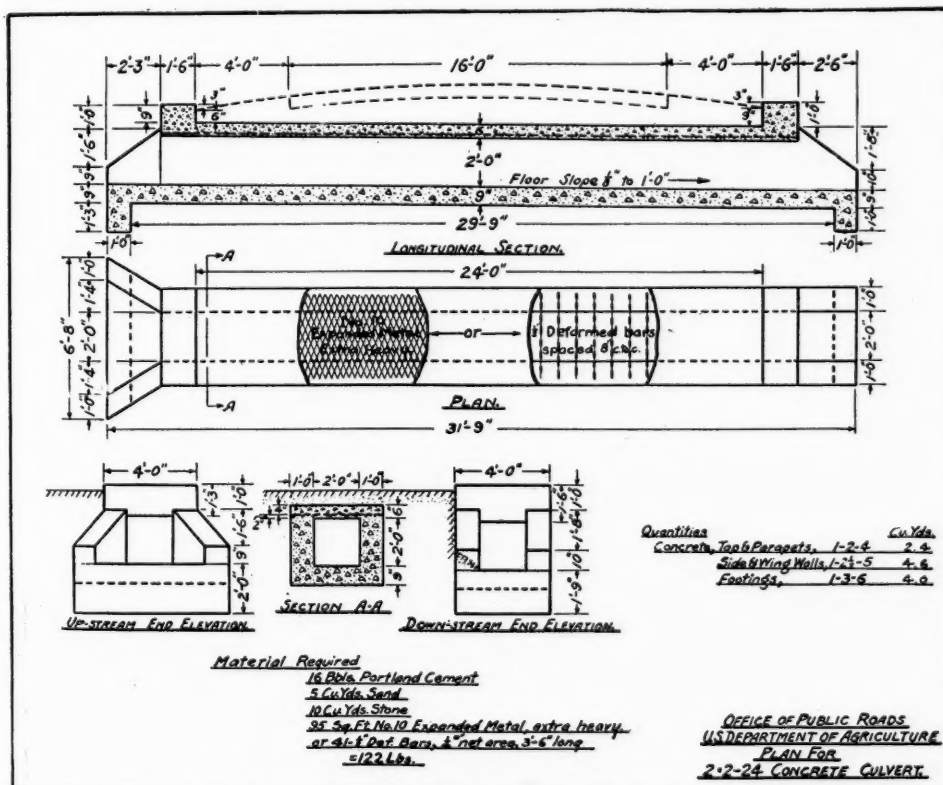


FIG. 3.—PLAN FOR A CONCRETE BOX CULVERT.

reinforcement placed near the bottom to strengthen the projecting portions of the footing. Footings should be protected from undermining, where they do not rest on rock, by rip-rapping the bed of the stream around them or by cut-off walls across the stream at the two ends of the culvert to prevent erosion of the stream bed at this point.

In many cases abutments and wing walls have not been built, but merely four piers or posts constructed to support the four corners of the bridge span, with a few planks behind them to hold up the earth approach, and the rapid destruction of the planks and consequent settling of the earth makes dangerous holes at the ends of the bridge, and the absence of wing walls has caused the bridge to be washed away by high water. The abutment serves a two-fold purpose; it supports the end of the bridge span resting upon it and it acts as a retaining wall for the material composing the approach to the span. The wing walls also serve as retaining walls and in addition as a protection to the banks of the approach to the bridge from erosion by the water currents. The abutments and wing walls must therefore be designed to serve these purposes. In general it may be said that the thickness of a retaining wall at the bottom should be at least 40 per cent. of its height, and this thickness should be increased where the filling back of it—in this case the bridge approach—is higher than the wall. Given a suitable foundation, if the abutment is designed heavy enough to withstand the earth pressure it will generally be sufficiently strong to support the bridge load.

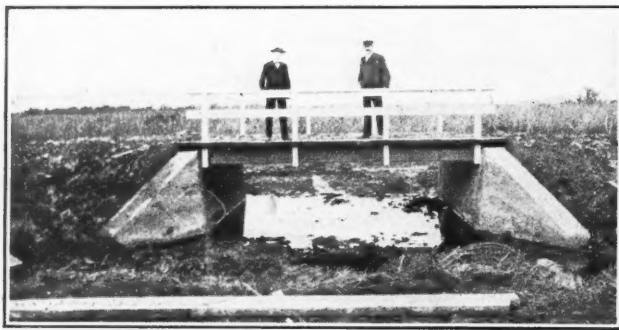


FIG. 5.—CULVERT WITH SUBSTANTIAL ABUTMENTS AND WING WALLS.

#### TYPES OF CULVERTS.

The simplest type of culvert or bridge is of timber beams with a plank floor, but while a timber bridge admits of theoretical design, there is no real need for its use to be encouraged, as its life is short and it is apt to become dangerous through decay. Concrete or steel is to be preferred for all culverts and bridges.

The simplest form of concrete construction is the concrete floor or slab resting upon side walls. The simplest construction for small culverts is the box culvert, which consists of a slab resting upon two sides which are continued in wing walls at the ends, and is provided with a floor of plain concrete or paved with stone. This type of construction is practicable under most conditions for spans up to 8 feet, which, as a matter of fact, forms a large percentage of all the culverts needed. The plan shown herewith gives the details of such a structure with a waterway 2 feet high and wide. Conditions may occur where it will be permissible to apply the box type, with some modifications, to greater spans than those mentioned, such as where the foundation is soft or liable to much erosion from swift currents. The floor may then be reinforced with steel so that it will have greater strength to act as a beam to distribute the load over a greater area; which floor may also be extended back of the side walls to act as a footing. With suitable cut-off walls to prevent currents of water from running beneath the floor, the foundation will then be well protected from erosion. Under such conditions this

modified type, with further modifications in the cover, may be practicable for spans up to 20 or 30 feet.

On main roads, where concentrated loads such as road rollers or traction engines are to be provided for and the depth of fill over the culvert is only sufficient to provide a cushion of earth from one to two feet in depth, the reinforced concrete slab is practicable for spans up to about 10 or 12 feet. Under conditions of less severe loading the spans may be increased up to 16 or possibly 20 feet, but it does not seem advisable to use them for these greater spans in view of the possibilities of future traffic requirements.

In some localities conditions may be favorable for building the footings and side walls of quarried or suitable field stone laid in cement mortar. These are not more serviceable than concrete, but may be more economical where crushed stone for concrete is expensive. These walls can be used for supporting concrete slabs. There are also cases where masonry walls or abutments have previously been built and covered with a wooden flooring, in which case the same walls may be used for supporting a substantial concrete slab.

Traffic should not be allowed to come directly on the concrete surface of the slab, but there should be an earth cushion of not less than about 18 inches in depth on top of it. This may require the raising of the grade of the road, but in most cases this would be an improvement of the road itself.

When the span exceeds 10 or 12 feet the reinforced slab ceases to be economical, and the reinforced concrete T beam type of construction becomes economically practicable. This type of construction has been designed for spans up to 50 feet long, but whether or not it is advisable for spans of this length may depend upon several conditions which must be carefully determined in each case. This construction consists essentially of a concrete slab reinforced by concrete beams spanning the opening and constructed monolithic with the slab; both beams and slab, but especially the former, being reinforced. The standard plan prepared by the Office of Public Roads for a 24-foot culvert gives an 8-inch slab supported by beams 12 inches wide and 22 inches deep, spaced 3 feet apart between centers, each beam being reinforced near its lower face by three 1¾-inch square bars spaced 4 inches between centers, and with 36 ½-inch round steel stirrups.

One of the best types of culverts for spans from 10 to 30 feet long is the steel I-beam encased in concrete, upon which rests a relatively thin concrete slab, which forms the cover for the culvert. The slab is designed to carry the necessary concentrated loads for a span equal to the distance between the steel I-beams, while the beams themselves are designed to carry the load over the entire span between side walls or abutments. I-beams may be used without encasing them in concrete, in which case they are painted to protect them from rust. The painting, however, must be repeated every few years at considerable expense, and there is a possibility that it may never be done; and the safest and probably most economical way is to protect them permanently by encasing them in concrete. Among the advantages of this type of construction are its safety and its ability to withstand severe and unfavorable conditions, such as the unequal settlement of abutments, which

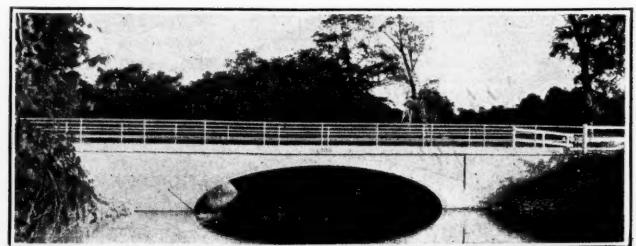


FIG. 6.—CONCRETE ARCH ON A MASSACHUSETTS STATE HIGHWAY.



might cause concrete slabs to fail. This type also admits of arch construction between the beams for the floor system, by which means space may be saved in the depth of the floor system which may be an important consideration where the head room is limited. The arch is at times both practicable and very attractive in design, providing an economical and serviceable bridge and one which harmonizes with landscape development. The arch may be constructed of cut stone, plain concrete, reinforced concrete or steel. It is, however, one of the most difficult types of bridge structures to design, and its strength depends upon an unyielding foundation, and it requires absolutely first-class materials and the highest skill in its construction. This type of structure should not be undertaken by inexperienced builders or with haphazard methods, but the services of a capable engineer should be secured and foundation and other local conditions should be known to be favorable. The arch culvert is well adapted for locations in deep ditches or ravines, where there is an abundance of head room. Where the arch is to be flat the use of reinforcement is advisable.

### CROSS-STATE HIGHWAYS

No provision is made in the State of Iowa for State aid or State control of highways, but to a certain extent co-operation between county officials has been substituted for this. In 1909 Senator La Fayette Young brought about the co-operation of the local road officers of the several townships across Iowa from the Mississippi on the east to the Missouri on the west, a distance of about 380 miles, and a continuous road was laid out and constructed across the State; and this has been succeeded by three other river-to-river roads.

The shortest of these, known as the Blue Grass road, runs through sixteen counties, each of which was assessed \$100 for organization purposes. This road follows the line of the C., B. & Q. railroad and is 300 miles long. The benefit to be derived from the road was realized by the 2,000 to 3,000 farmers along the route, and communities contested for the privilege of having the road pass through their boundaries. Over \$40,000 was donated by those along the line and was used in cutting down hills, making large fills, building new bridges and buying right of way for straightening the road. Over 200 concrete bridges and culverts were constructed at a cost of \$50,000, and the supervisors of most of the 16 counties through which the road runs have agreed to use nothing but permanent construction in the future for bridges and culverts along this road. In addition, over 1,200 farmers signed agreements to drag the road, but these agreements are no longer necessary, as a new state law makes it mandatory on the trustees of every township to employ a superintendent of dragging who shall make contracts for dragging every mile of road in the township.

During the last two years about 30 cross-state roads have been organized in Iowa with a total length of about 5,000 miles, and over \$500,000 has been donated by men along the various routes and used in improving these cross-state highways.

Cross State roads are being advocated in South Dakota also. One known as the Meridian road is planned to run north and south through several States from Galveston, Tex., to Winnipeg, Man., passing through Yankton, Sioux Falls, Watertown and White Rock in South Dakota. Two others are projected, one extending from the Minnesota line west through Brookings, Pierre, Rapid City and Deadwood, thence through Wyoming to the Yellowstone National Park. The other road is designated as the South Dakota Scenic Highway, and will extend from Sioux Falls west through Mitchell, Chamberlain and Rapid City to the Black Hills.

The idea of cross State highways is, in fact, one of the

first to receive practical attention in the majority of States, there being several excellent reasons for this. One is that it furnishes an easy and easily defended plan for distributing State work through a considerable section of the State, with the minimum of trouble in apportioning the expenditures among the several counties, where all are asking for immediate aid. It furnishes a continuous route for long distance automobiling, and it may frequently be made a part of an interstate or even a cross-continental route. There is also a "bigness" to the title "Cross State Road," which would be more likely to impress the popular imagination than scattered roads throughout the State, which might total double the length.



Courtesy of Milwaukee Sentinel.

### RELOCATION OF A WISCONSIN ROAD.

By which a 12 per cent. grade was changed to an 8 per cent.

### POWER SPRINKLING WAGONS

FLUSHING wagons which expel the water under air pressure or by means of a gasoline pump have become more or less common in the larger cities of this country, but we believe that wagons for sprinkling by pressure and at the same time driven by their own power have not yet been introduced here. A number of cities and towns in France have begun using them, and also in certain other European countries. Such a wagon is shown in the accompanying illustration from a photograph of a type now employed at Versailles.

An 800-gallon tank is mounted on an automobile truck and a vertical 4-cylinder gasoline motor of 25 h.p. is placed under the driver's seat. This is arranged to give three speeds forward and one back, these varying from 12 miles to 3 miles an hour. This motor is connected with the rear axle by jointed rod transmission. A turbine pump, which is operated by the gasoline motor and can be thrown in or out of connection by the driver, forces the water from the tank through two spraying nozzles at the rear of the wagon which discharge the water at right angles to the axis of the wagon and are capable of covering a maximum width of street of about 46 feet. The engine and nozzles



FILLING SPRINKLER WITH SALT WATER, SANTANDER, SPAIN.



POWER SPRINKLER AT VERSAILLES, FRANCE.

are designed to discharge 50 gallons a minute through this width of roadway, or about one gallon per foot of width, and the amount per square yard of pavement can be regulated by changing the velocity of the wagon, or the driver can regulate the amount of water discharged without leaving his seat, either reducing or entirely shutting off either or both nozzles. When working close to the sidewalk the nozzle nearer the curb is usually shut off. In a recent trial for a prize by the War Department, this wagon was run 60 miles with 10 gallons of gasoline, 0.4 gallon of lubricating oil and 1.5 pounds of grease, winning the prize.

Another wagon of the same kind, adopted at Santander, Spain, for use on one of the wide avenues near the sea, is shown in the other illustration pumping up sea water into the tank by means of its own pump, it being thought that salt water would keep the dust laid better than would fresh water from the municipal water system.

### MOTOR ROAD REPAIR WAGON

For Trucking and Hauling—Electric Motor and Hoist—  
Tar Heater—Road Sprinkler—Carries Tools  
and Eight Men

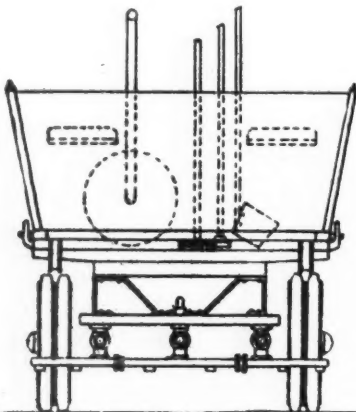
THE maintenance of the thousands of miles of highways which have been constructed during the past two or three years is, in the opinion of Logan Waller Page, Director of the United States Office of Public Roads, a problem which is already beginning to assume serious proportions, which will rapidly increase during the next few years. He believes that the patrol system, such as has been used in France for a great many years, will not meet the conditions of bituminous macadam roadways in this country. When such a road begins to need attention it is generally because of the disintegration of the binder, bringing about loose spots on the surface. For a patrolman to repair these is expensive, for a tar kettle, stone and small tools are necessary. Such work can be done better and more quickly with a small gang of men, who can repair a considerable length of road in a very short time if a quickly moving vehicle to transport them and the equipment is used. On roads having a bituminous blanket coat, this method of maintenance is even more applicable than on roads built by the penetration or mixing method. Impressed with this idea, the director of the Office of Public

Roads some months ago engaged a prominent motor wagon designer to devise a motor maintenance car, and the result, which is recommended by the Office, is described by Logan Waller Page in the April 1 issue of the *Power Wagon*, to which we are indebted for the two illustrations shown herewith, and whose description we abstract as follows:

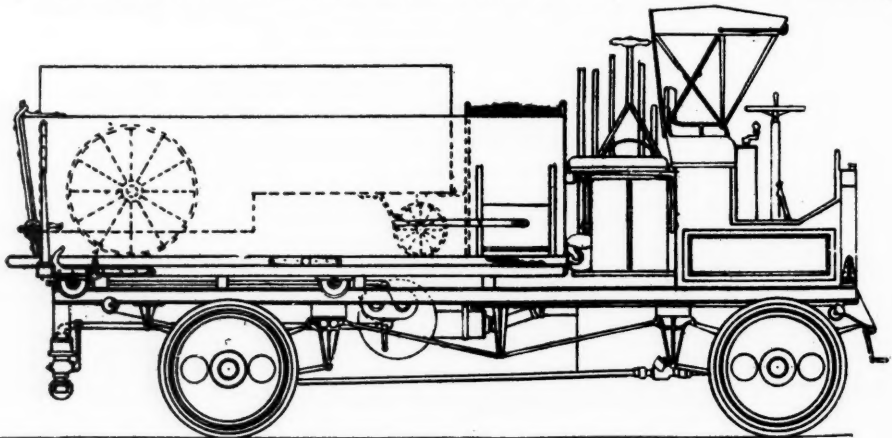
The object aimed at was the development of an auto equipment which would include all the apparatus and facilities necessary to efficiently employ a repair gang of eight men in the maintenance of road surface over one hundred miles or more of roadway. Three important requirements were: First, that the cost of the equipment should be kept consistently low or within the range of customary expenditures in this direction; second, novel or especially manufactured apparatus should be avoided, so that equivalent apparatus could be secured in any locality, and further, that existing investment in similar details of equipment can be made use of; third, that the outfit be so flexible in its makeup as to readily serve a variety of utility or lend itself to peculiar requirements under varying conditions.

These conditions necessarily prohibit the employment of any cumbersome or expensive traction trains and demand rather a single machine with ability to handle a single trailer where such may be required. This machine should be capable of performing all the useful transporting functions required in road repairs, as well as being serviceable for maintenance work, such as the distribution or sprinkling of road oils, or bituminous material, and furthermore, should be available during the winter season for general trucking purposes, such as snow and refuse removal or other hauling service. In performing service in road repairing the machine should incorporate as many of the requirements of a portable power plant as possible, such as hoisting, pumping and, where necessary, air compression and power shaft driving. It should have considerable traction ability and be capable of operation at a reasonable speed when loaded, as well as a higher speed for empty return trip or emergencies. The equipment should carry the necessary amount of apparatus and enough road repair material for a number of quick repairs in isolated places, when these are not very extensive. Where extensive repairs are necessary and require considerable material the equipment should be flexible enough to provide rapid conveyance of stone or other material from a distant supply station to the place of operation.

The outfit designed consists of an auto chassis, a five-ton gas-electric couple gear being the one especially recommended. This chassis, in addition to its regular equipment, is fitted with a Sprague electric hoist, the purpose of which is to aid in loading and unloading the body and other apparatus which the machine carries, as well as for general hoisting external to the machine whenever required. The electric motor of this hoist is direct-connected to a rotary pump, which is used to force the road oil or bituminous material from a tank, carried on the machine,



END VIEW, SHOWING TOOLS AND SEATS.



OUTFIT READY FOR SERVICE—TAR KETTLE SHOWN BY DOTTED LINES.



through a distributing device permanently attached to the rear of the chassis. This electric hoist and rotary pump are located forward and at about one-fourth of the distance from the rear to the forward wheels, below the floor of the body, which rests on the chassis.

This chassis can be fitted with a removable platform body of any convenient or desirable dimensions, with or without stakes or side racks, when the machine is used for hauling purposes in those seasons of the year when road work is not feasible. It may also be fitted with a steel dumping body having a length of 130 inches, a height of 36 inches, a bottom width of 56 inches and a top width of 78 inches. The forward one-half of this body should have two removable partitions, so placed that one cubic yard of material can be carried in the forward space and two cubic yards of material in the rear space. Each of these two spaces should have vertical sliding side doors, operated by hand levers, to allow material to be unloaded from the floor of the body rather than over the sides. The purpose of these removable partitions is to provide for carrying a variety of road material, or to carry a limited amount, and to permit the balance of the body being used for other purposes. This body should be so located on the chassis as to leave sufficient space behind the driver's seat and in front of the dumping body for carrying tools and men. It should be possible to entirely remove the body when the machine is required for use as a platform wagon. This steel body can be dumped either by hand winches, or by a proper arrangement of pulleys, utilizing the electric hoist for this purpose; the electric hoist also being used for lifting the dumping body onto or removing it from the chassis.

The next essential part of the equipment is a tar-heating kettle of sufficient capacity to be serviceable on the roadside for repair work or to serve as a distributing tank wagon when carried on the machine. Mr. Page recommends a 500-gallon kettle mounted on wheels and of such dimensions that it will occupy all of the dumping body but the forward one-yard space referred to. About the only change necessary to adapt any of the standard tar-heating kettles to this purpose would be the shortening of the rear axle. One of the illustrations shows such a tar kettle in position in the dumping body, and the other shows the kettle being loaded into the dumping body by means of the power winch.

Provision should be made for carrying eight men, four on the driver's seat and two on each side of the tool-carrying compartment, between this and the dumping body. It is presumed that the foreman of the gang will operate the machine.

When the machine is to be used for sprinkling road oils or spreading bituminous material, the tar kettle is loaded into the steel body, and by means of a direct connection at the back of the machine the rotary pump is supplied with the liquid material from the kettle, which it forces through the spreader. A removable rear seat is provided for the

operator who controls this service. In long trips away from the place of supply for bituminous material an additional supply of barrels may be carried in the forward compartment.

Should the employment of a tar kettle for this purpose be considered inadequate, a complete tank equipment could be provided and placed on the chassis when required for this service. In the event of compressed air being desirable for any part of the work, the machine can be fitted with an electric air compressing outfit.

When doing isolated patchwork over a long stretch of road the small stone compartment may be replenished at stone supply stations along the route. It is suggested that there be provided, at various points on the system of roads to be cared for, a number of supply stations where stone and bituminous material would be kept on hand, which stations could be periodically replenished by the machine under consideration.

The department estimates the approximate cost of the total equipment suggested to be as follows:

Machine, with steel dumping body.....	\$6,000
Sprague electric hoist .....	250
H.P. spreader, with rotary pump and piping.....	700
Tar kettle, 500 gal. capacity.....	300
Double kerosene burner outfit.....	200
Tools and accessories .....	50

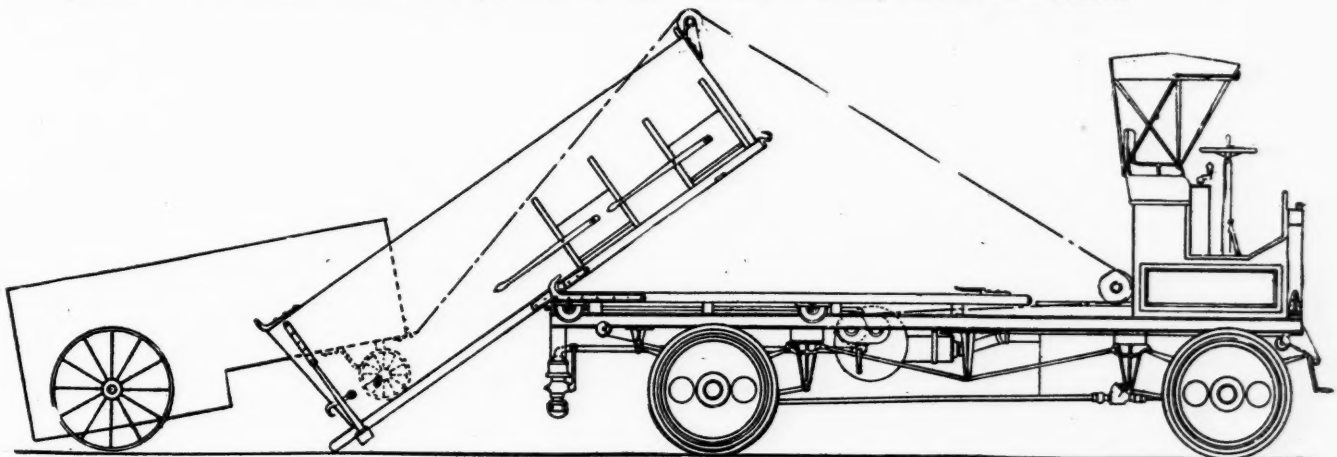
Total ..... \$7,500

#### DUST LAYING IN WASHINGTON

DURING the year 1911, considerable oil was used for dust laying and road-preservation in the District of Columbia, and five steel tanks, each containing 15,000 gallon of oil for road use, were erected at various railroad points. Oils of several kinds were used, including a considerable amount of emulsified oil. The latter is found better adapted to residence streets where there is much foot traffic, on account of being less adhesive to the feet when first applied. It is also less expensive. The heavier oils were found to be best adapted to roads carrying a large percentage of automobile travel, and the lighter oils to those where there is considerable heavy hauling or which have a very loose surface. The selection of an oil for a particular road is thus dependent upon the character of the surface and of the traffic.

The use of Tarvia B and Tarvia A and calcium chloride were continued, each giving good results relative to their cost. The calcium chloride was found to be especially advantageous on residence streets with only local travel, as streets where it was used always presented a clean, damp appearance.

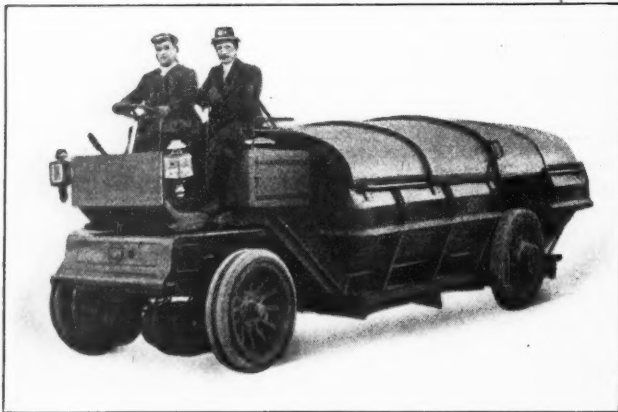
The cost of application of a heavy bituminous binder by the penetration method is from 20 to 25 cents per square yard for a layer 2 inches thick, and by the mixing method varies from 93 to 98 cents by contract. A portable mixing plant would enable the district to do such work by hired labor for much less than this, in the opinion of Superintendent of County Roads L. R. Grabill.



LOADING TAR KETTLE—STEEL BODY IN DUMPING POSITION.

### FRENCH REFUSE WAGON

A NEW electric automobile wagon is now on trial in the city of Paris, and as a result of the present experiments it has been practically decided to adopt for use a wagon of at least this general type. Horse vehicles of a large size have been used in the city up to the present time, but the use of the automobile is found to be a great improvement, both in facilitating speed and permitting the carrying of a greater bulk of material. A large majority of the dwellings in the city are in the form of apartment houses which have only a front entrance, which requires the collection of all the household wastes to be made from the front sidewalk. For this reason it has for years been required that each dwelling be provided with one or more large galvanized iron cans. These are set out in front of the house at a very early hour in the morning so that the contents can be collected by the wagons in the minimum time and as much of the work completed as possible before business hours. The new automobile wagons, one of which is shown in the accompanying illustration, are intended to hold 420 cubic feet of refuse, weighing  $4\frac{1}{2}$  to 6 tons. The daily run for the wagons is about 22 miles, of which four miles is occupied in the actual collection from the houses.



PARIS AUTOMOBILE REFUSE WAGON.

While making collections it is required that the wagon run at a very slow speed, with a stop before each house. In this design the box body is entirely separate from the front truck, which latter carries all of the electrical and mechanical motive apparatus and can be at once removed when necessary. The top part of the front truck is occupied by a large box containing 45 storage battery cells, and there is a separate electric motor of 6 horsepower placed against each of the wheels. The standard running speed is 8 miles an hour. The total weight of the wagon is 6.4 tons.

The box body is covered with separate sections of sliding covers, so that only a part of it need be opened at a time. During the collection, while the speed is being kept quite low, a special appliance permits the wagon to be controlled from the side, the object of this being to allow the driver to aid in loading the material into the wagon and at the same time control, guide, start or stop the wagon at will from the sidewalk. This practically reduces the force necessary by one for each wagon. The wagon has a bottom dump for unloading the material into the incinerator or onto the dump.

### INCREASING USE OF BITUMENS

THE increasing use of bituminous materials in street paving and road building, and also a change in road building methods, are indicated by the annual report for 1911 of the General Asphalt Company, the owner of the Barber, Trinidad and Bermudez companies, which shows that the total value of business of the company increased from \$16,004,173 in 1910 to \$16,542,281 in 1911; the most significant feature, however, being that for the first time the income from the sale of crude and refined asphalt and asphaltic

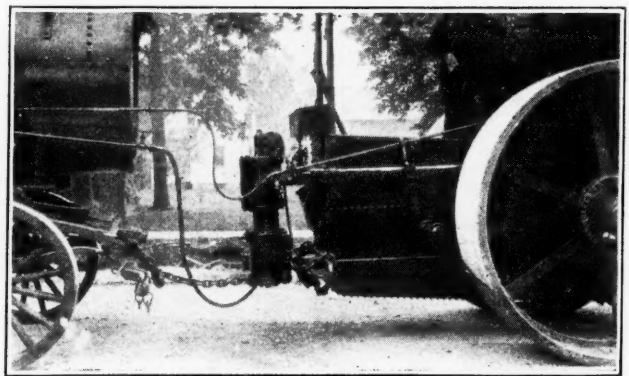
products exceeded the paving account of the company. The sales of asphalt increased from 247,491 tons to 265,677; this indicating that a larger proportion of the asphalt was being purchased direct by cities, States and other builders and maintainers of roads for use for those purposes, and that less dependence was being placed upon contractors for asphalt construction.

### ILLINOIS PRESSURE SPRAYING OUTFIT

THE Illinois Highway Commission last year devised a steam spraying outfit in which the bituminous material is heated in a heater wagon of large capacity. This is drawn by a steam road roller, and the steam from the boiler is carried through pipe and hose to the spraying nozzle, where it issues together with the bitumen, giving velocity to the latter somewhat on the principle of the injector. At the back of the roller is connected an air pump, which is operated by steam, and is connected with the top of the



CONNECTIONS AT BACK OF DISTRIBUTING WAGON, REFILLING TANK.



AIR PUMP AT REAR OF ROLLER AND PIPES TO TANK AND SPRAYER.



SPRAYING DEVICE IN ACTION.

heater wagon tank. This furnishes pressure for expelling the bitumen through the nozzle, and also a vacuum for filling the tank by sucking in hot tar through the nozzle hose. The steam connection to the nozzle is also carried to the tank end of this hose, and is used for blowing steam through the latter to clean it out whenever work stops.



## NEWS OF THE MUNICIPALITIES

Current Subjects of General Interest, Under Consideration by City Councils and Department Heads—Streets, Water Works, Lighting and Sanitary Matters—Fire and Police Items—Government and Finance

### ROADS AND PAVEMENTS

#### Prospective Road Legislation in Arizona

Phoenix, Ariz.—Before the present Arizona legislature adjourns President T. G. Norris, of the Arizona Good Roads Association, hopes to procure an appropriation of funds, by the use of which the roads of Arizona will be logged and mapped. Similar action is sought by New Mexico.

#### Will Treat Roads with Oil and Tar

Elizabeth, N. J.—The township authorities will begin the oiling of the macadamized roads of the town next week. Each street will be swept and the oil applied plentifully. The new roads of the town completed last year, which were not oiled, will be given a treatment of tarvia. The county intends to improve North avenue, west, from the business section to the Aeolian works with amiesite. Springfield, Union and Walnut avenues and Eastman street are badly in need of oil, as these roads have been used to a big extent by the drivers of pleasure cars passing through the town.

#### Maintenance Work in Schenectady County

Schenectady, N. Y.—The county roads will be maintained under the direction of Mr. Creiger and the town superintendents of roads. Of the eight miles of macadam county roads about half will need no repairing and the other half will need some fixing over. This county macadam roadway is about two miles of the Aqueduct road, two miles of the Van Antwerp road, a mile of the High Bridge road, a mile of the road in Carman, a half-mile at the end of Crane street and a mile and a half in Duanesburg. The gravel roads are in bad condition and will require considerable repair work to put them in shape again. This is also true of the earth roads, but all this is expected to be completed early in June. Gravel roads are more easily repaired than those of macadam. Mr. Creiger has six traction engines and their equipment of cars and wagons besides ten teams of horses and fifty men.

#### Janesville Investigates Road Oils

Janesville, Wis.—Suppression of street dust by the application of heavy asphaltum oil will be extended in Janesville this year. Arrangements have been made between L. E. Babcock, local agent of the Standard Oil Company, and abutting property owners for the oiling of South Main street from the end of the brick pavement to the Buob brewery, two blocks on East street, North Jackson street and North and South High streets. Edward Murdoch, who did the soliciting for Mr. Babcock, is still at work and meeting with gratifying success. Oil dust layer was given a very satisfactory trial on a number of Janesville streets last year and little argument is required to convince people of the advantages of its use. South Main street will be the first street to be treated this season and if weather conditions are favorable the work will be begun early next week. It will be paid for by the abutting property owners, according to the extent of their frontage on the street. The oil to be applied is 65 per cent. asphaltum. The city of Milwaukee has ordered 700,000 gallons for use on its streets this season. City Clerk J. P. Hammarlund, at the direction of the council, has written the city officials of Racine, Kenosha, Rockford and Freeport for information or copies of their ordinances governing the sprinkling of streets with water and oil. Madison officials will also be communicated with, as that city secured a thorough trial of oil dust laying. With the information secured through these inquiries an ordinance adapted to local conditions will be drawn and submitted. The only reply to inquiries received thus far is from Leslie M. Fowler, city clerk of Racine. He writes that his city has not yet experimented with oil dust laying, but that Asylum avenue, the main approach to the city from the southwest, will be macadamized and oiled this summer. Sprinkling is done by contract, and costs from 9 to 15 cents per running foot.

#### Street Over a Big Cave

Centralia, Pa.—Bore holes drilled in the main street of this town, fenced off several weeks ago, when it showed signs of dropping into a Lehigh Valley Coal Company mine, developed rather startling results. The first drill broke through into empty space when it reached a depth of 60 feet, while a second hole a little farther west went only 20 feet before the bottom dropped out. Until the unsettled section of the street was fenced off and closed to traffic trolley cars and heavy teams operated upon it daily. A shaft is now being sunk, which will be timbered and slushed with culm.

#### Children Campaigning for a Decent Street Pavement

Reading, Pa.—Benners court, one of the smallest thoroughfares in the city, has sprung into prominence by reason of a petition signed by the children of the neighborhood demanding that the street be paved. The action of the children, inspired by Katherine Kline, fourteen years old, who started the petition, has been widely discussed throughout the city. Children of other parts, whose play, limited to the streets, must be curtailed because of the poor condition of the highways, are considering a similar movement. Upward of 125 children, ranging in age from five to fifteen years, attached their names to a petition which was presented to the councilmen of the ward. The children are now considering the plan of calling upon councils or the mayor to see what can be done. They want the street paved so that they will have a place for roller skating. This is now covered with a black sandy surface, and it is very uneven. The youngsters living in Benners court say they want nice streets like those other children of the city enjoy.

#### High Praise Given to Highways of Wayne County

Detroit, Mich.—Splendid tribute to Wayne county roads was paid by Paul D. Sargent, assistant director of public roads, United States department of agriculture, who spent a day in a critical inspection of some of the roads constructed under the direction of the county commissioners. Mr. Sargent asserted that never had he seen better roads than those in Wayne county and he has traveled all over the country on inspection trips. Mr. Sargent was a guest of County Road Commissioner Edward N. Mines, who entertained also a number of other visiting road experts, including the Kent county road commissioners and O. H. D. Rohwer, of Chicago. In an automobile the party was driven to the end of the concrete roads on Grand River, Woodward and Michigan avenues and to the county line on Fort street. With each thoroughfare traversed Mr. Sargent's admiration increased until at the completion of the day's trip he had difficulty in finding words to express his gratification at the work of the Wayne county commission. "In the east where good roads are proverbial, I found none better than those I traveled over," he said. "And I have seen no better ones in a dozen States I have visited. I desire also to say that never have I seen a better road building equipment and organization than Wayne county possesses. High efficiency all along the line seems to be the motto of the road commission here. Mr. Sargent is an accredited authority on goods roads and road building. He was formerly State highway commissioner of Maine, is a well-known road engineer, and has made the subject of good roads his life's work.

"I am impressed particularly," he said, "with the apparent permanency of the Wayne county roads. Your commission appears to have solved the problem of good roads and my personal conviction is that other States and counties will adopt the concrete or brick road as Wayne county has done. It has been determined that the macadam road does not stand up under the automobile traffic. The concrete road withstands the traffic of the automobile and horse equally well. I am impressed also with the cleanliness of Wayne county roads. They are free from dust and are splendid automobile thoroughfares."

### Parking of Montana Street to Commence

Butte, Mont.—Active work toward beautification of the streets of the city by the planting of trees will be commenced under the direction of City Engineer Gow. The matter has been under discussion by the municipal committee of the chamber of commerce, which met with the city council, the board of county commissioners and the city engineer. It was decided to park one city block on Montana street, from Quartz to Granite street. A space seven and one-half feet wide on each side of the street, between the sidewalk and the street, will be laid out and sown with blue grass and clover. The ground will be prepared by a layer of about eight inches of the best dirt to be obtained. The best of Canadian poplars will be planted in a row in the center at a distance of about 18 feet apart. The street will be graded and crowned. This one block of parking will be done merely as a sample of what may be done in event of successful growing of the trees, and under proper care there does not seem to be a doubt that the experiment will prove so successful that general enthusiasm will be aroused and the planting of trees may become general in the residence sections of the city.

### Electric Driven Crusher Installed

Cranston, R. I.—The Cranston highway department has begun the season's work with larger plans than those of any season for years. The new crusher has been installed and started up at the city ledge on Phenix avenue. Those at the head of the department say the capacity of the plant is to be 200 tons of stone a day. Electric power has been substituted for steam power for the operation of the crusher and also for the air compressor, which runs two drills. The boiler of the old crusher engine has been set up in a new building to supply steam for two steam drills. The two steam drills are set up on the ledge and used to sink deep holes in which dynamite is placed to break off great masses of the ledge. The fragments are thrown down and then the compressed air drills are to be used to drill the fragments, so that a second blasting on a smaller scale may be carried on. The fragments are still further broken by hand. A miniature railway leads from the ledge to the crusher and the dump car empties the stone directly upon the platform at the crusher jaws. The old steam roller has been repaired and both are now at work on highway jobs. The plans for the season include the rebuilding of a number of the main highways of the city and in addition two pieces, about ten miles of State road, for which the city has secured the contract.

### Improvement Work to Start at Once

Muncie, Ind.—According to the statement made by City Engineer B. F. Deardorff, the oiling of the streets will be made, under the direction of Charles W. Maddy, at an estimated cost of \$10 per square block. This figure will, of course, vary according to the conditions in which the streets may be found. Already ten barrels of Perennial Prime White road oil, which will be placed in use as an experiment, have been ordered. Mr. Deardorff stated that the board of works was pushing the repair of the streets as rapidly as possible. There has been provision made for the improvement of the asphalt streets in the different parts of the city. If the street has been previously oiled, say the year before, it will not be necessary that the oil be spread so thickly as it must be upon a newly-oiled street. The newness and oldness of the street to be oiled will also have no little effect upon the cost. If the road is compact and settled, then the oil will not soak in and hence will not require the amount of oil that the new street will require. The quality of the oil will also have a great deal to do with the matter at hand. Should the oil be of the best, thick, and able to remain upon the top of the surface it will not be necessary to use the amount of oil which must be used should the oil not be of the quality described. Those in charge of the oiling in this city have decided that they will try the White road oil. It is a colorless liquid, which, when placed upon the street, leaves no dark stain so familiar with the streets where the common road oil is being used. At the present time Richmond is the only city in the State that has gotten past the experimental stage with the Perennial Prime White oil.

### Condition of Roads Interests Auto Club

Belle Fourche, S. D.—The Belle Fourche Auto Club has inaugurated a system of caring for its roads that is worthy of emulation. They have constructed a large sectional map of the entire country for twenty miles about Belle Fourche in all directions, marking thereon the roads leading to the city. This map is hung in the auto club rooms, and people are generally invited to report any place which is particularly bad, or which needs some special attention. This place is located on the map. The next time any of the members of the auto club have occasion to go over that road they are asked to take the matter up with some of the parties in the neighborhood—the road overseer or county commissioner—to the end that it may be repaired. In some cases spots are reported which can be fixed in an hour's time with a shovel. In this case they simply take the shovel along and fix it. The plan has the advantage of being very practical, and can be easily worked. The auto club is very much alive in the matter of good roads this spring.

### Prospective Road Legislation in Nebraska

Lincoln, Neb.—The legislative committee of the State Automobile Association is preparing three measures to be introduced at the next highway session of its legislators. First, there is a provision for a State Highway Commission, and it follows as a natural sequence that there must be State aid in construction and maintenance. Another law will be one permitting the use of convicts on the roads, a plan followed most successfully, principally through the South, though also being adopted quite generally in the West. Even New Jersey's Legislature adopted a law permitting the use of convicts in roads building. The particular reason why the Nebraskans are starting this early is because they intend to consult with legislative candidates, and will only support those who believe in up-to-date highway laws.

### Figuring Cost of Repairing Asphalt

Trenton, N. J.—Mayor Donnelly is collecting information regarding the cost of repairing asphalt pavements. He finds that in Camden, N. J., where work is done by the city, using old material, that after crediting the profit on work done for public service corporations to the city's work, the net cost to the city was in 1911 25½ cents per square yard. The actual cost of the work was about 50 cents per square yard. The statement obtained from Street Commissioner Alfred L. Sayers is as follows:

Repairs to asphalt roadway made by city corps, March 9, 1911, to December 1, 1911:	
4,312	yards of asphalt, city portion.
1,526	yards of asphalt, Public Service Railway Co.
35 2-3	yards of asphalt, Public Service Gas Co.
99	yards of asphalt, Delaware & Atlantic Telegraph and Telephone Co.
4	yards asphalt, plumbers.
5,976 2-3	Total number of yards laid, at a cost of \$2,972.59.
1,526	yards repaired for Public Service Railway Co., at \$1.....\$1,526.00
35 2-3	yards repaired for Public Service Gas Co. at \$2.53 ..... 89.86
87	yards repaired for Delaware & Atlantic Telegraph and Telephone Co., at \$2.53. 220.11
12	yards repaired for Delaware & Atlantic Telegraph and Telephone Co., at \$2.51. 30.12
4	yards repaired for plumbers, at \$2.51..... 10.04
Total receipts .....\$1,876.13	
5,976	yards laid at a cost of..... 2,972.59
1,664	yards laid for Public Service Corporation and others, at a cost of..... 1,876.13
4,312	yards laid for city, at a cost of.....\$1,096.46
Contractor's price for doing this work would have been \$1.35 per yard, or..... 5,822.20	
Less actual cost for laying by city..... 1,096.46	
Showing a saving to the city of.....\$4,725.74	



**City Repairs Pavement at Less Expense**

Cortland, N. Y.—At a meeting of the Board of Public Works, Superintendent E. L. Becker reported that repairs to the Main street pavement, made by the city, cost \$730. The asphalt company's price for doing the same amount of patching was \$1,800.

**Will Use Lighter Oil This Year**

Urbana, O.—Street oiling will be started. One car of oil has arrived and will be applied as soon as possible. On all streets which are sufficiently wide to allow it, one side of the street will be oiled and allowed to stand several days before the other side is similarly treated. In the business district one side of the street will be closed until the oil has had time to soak in, which will require about two days. A lighter grade of oil will be used this year than that used last season and much better results are expected. Last year the oil did not soak into the street surface for any depth, consequently many parts of the streets became dusty in a short time. Service Director McCarthy had intended to purchase a street sweeper in order to remove all dust before oiling, but when the matter was taken up with the manufacturers it was found that they would not recommend a sweeper where the surface is of a soft material.

**SEWERAGE AND SANITATION****Health Board Orders Bread Wrapped**

Pineville, Ky.—After May 15 all ordinary loaf and bakers' bread offered for sale in Bell County must be separately wrapped in clean paraffine paper specially prepared for that purpose. The County Board of Health of Bell passed the resolution at its last meeting pertaining to the sanitary method of offering bread for sale.

**City Plans to Fill in South Bay**

Boston, Mass.—Gradual elimination of the South bay and a portion of Fort Point channel by dumping refuse is stirring the residents of South Boston to oppose the filling in of this large area of water and mud flats as proposed by the mayor and the commissioner of public works. This plan includes the installation of a new sewerage system for South Boston at a total cost of \$9,000,000. A report on the conditions existing along the mile and a half of waterway with a width of from one fifth of a mile to a mile is soon to be made to the port directors by the engineer. Upon this data the directors will base their answer to Louis K. Rourke, commissioner of public works. It is understood that the directors desire to maintain all of the waterways and channels of the harbor, especially when they prove to be lanes of transportation. The South bay carries a commerce of nearly 2,000,000 tons a year.

**Storm Water Drain Nearing Completion**

Atlantic City, N. J.—The \$840,000 concrete sewer under Baltic avenue is nearing completion. This structure is nearly two miles long. A section of about five blocks remains to be excavated. It is expected that the work, which first started in March, 1911, by the W. G. Root Construction Co., will be completed by Aug. 1. At each end of the canal the pumping stations are finished and the pumps are in running order, as are all but two of the five intermediate gateways. These gateways are located at Missouri, Ohio, Tennessee, Pennsylvania and New Jersey avenues, and they divide the duct into seven sections for cleaning or repair purposes. Inside the finished section of the duct the concrete walls are as smooth and well finished as the best of concrete pavement. The side walls are 10 feet 6 inches from each other, wide enough to run an automobile through, and are seven feet six inches high at New York avenue, but at either end they are 10 feet 6 inches high at the two outlets, or rather the bottom of the drain is lower, the drain sloping in each direction from New York avenue to give a gravity flow at the rate of three feet the mile. The pumping stations at Rhode Island and at Georgia avenue are provided with an electric engine, which operates the pumps for cleaning the canal and also lowers and raises the flood gates by means of a huge bronze screw. The company dredged Gardner's Basin so that there is eight feet of water there at low tide. The pumping stations are trim little concrete buildings with red-tiled roofs. Associated with T. Chalkley Hatton, who designed the canal, are John H. Decker and City Engineer F. B. Mount.

**Urged to Swat the Fly**

Topeka, Kan.—Each of the 485 incorporated towns of Kansas has been asked by the State Board of Health to enact a drastic anti-fly ordinance at town meetings to be held the first week of May. The ordinance as framed by the health board provides that all garbage must be kept in covered vessels and removed twice a week, and that places where flies are likely to gather or lay eggs must be covered or screened.

**Will Build 60 Miles of Sewers in Year**

St. Louis, Mo.—Sixty miles of new sewers will be built, at a cost of \$3,000,000, in St. Louis during the present fiscal year, according to the plans of Sewer Commissioner Charles A. Moreno. The mileage will exceed any ever laid by the city in one year. Last year 44 miles, which was a record, were laid. The largest piece of work for the year will be the north branch of the Harlem Creek sewer at a cost of \$300,000. This sewer will begin at the city limits and Bircher street and extend to Bircher street and Newstead avenue, where it will join the south branch of the Harlem Creek sewer. The new sewer will be 12 feet in circumference at its mouth. Both the north and south branches empty into one sewer at Bircher street and Newstead avenue. Work is just beginning on the Rock Creek district sewer, which starts at Fyler avenue and King's Highway and extends southward to the new River des Peres sewer, also in course of construction. Moreno expects to finish the second section of the River des Peres sewer this year, thereby completing a continuous line from Lindenwood station on the Frisco, following the River des Peres to the Mississippi River. Thirty-five per cent. of the work remains to be completed. Work is now being carried on in 10 different places.

Other new work to be done this year will be on small pieces of sewer in different parts of the city. The Sewer Commissioner, when the money is available to connect the long gap that will exist between the River des Peres sewer, ending at Lindenwood, and the foul water des Peres sewer, which begins at Clemens avenue and the city limits and extends to a point near where Union boulevard touches Forest Park. At present the sewage is pumped from wells at the Union boulevard end of the North des Peres sewer to the Pine street sewer. Moreno estimates the two sewers can be connected, by following the bed of the river, for \$350,000. The decision of the Missouri State Supreme Court which ranks special tax bills over first deeds of trust was as beneficial to sewer districts as to streets, Moreno said. Of the sewers in course of construction or planned, the des Peres sewer is the only one being built from public funds. The others are special tax sewers and are paid for by the people directly benefited.

**WATER SUPPLY****Motors Use Much of Filtered Water**

Cohoes, N. Y.—At a recent meeting the Water Board discussed the purchase of a new Worthington centrifugal pump to work in connection with the Dean pump now in use. The amount of filtered water used averages 7,000,000 gallons daily, and of this a large amount is used in motors. A communication from the Cohoes company stated that while it furnished it free to the city, it charged for private uses. The company requested the board to take the matter up, and Inspector Fred Ostrander was ordered to ascertain how many motors were being used.

**Install New Filter at Water Works Plant**

Rome, Ga.—The new filter tub has arrived and will be installed at the water works department as soon as an expert who is on the way from Philadelphia reaches the city on that mission. The filter has a capacity of 500,000 gallons and will increase the capacity of the city's plant to 2,500,000 gallons, sufficient to insure clear and pure water to the consumers, who have been suffering from the inadequacy of the plant to supply the consumption. Superintendent A. W. Walton, of the public works, says that the new filter tub will be in place in a few days and the situation will be temporarily relieved at least. He states, however, that there is a great waste of water and no permanent relief is in sight until the city installs the meter system.

### New Water Supply

Corning, N. Y.—The Common Council have voted to empower a special committee to seek out a new permanent source of water supply for the city to take the place of the one the contamination of which has produced the typhoid epidemic now in progress. The action was recommended by Sanitary Engineer Hooker, sent from Albany to make an investigation. Wells will be driven on the hills in the hope of getting a supply there. Failing in that, the Chemung River water will be filtered.

### Dallas Is Supplied With Ample Water

Dallas, Tex.—Prepared to face, if necessary, eight months of continuous dry weather, and then equipped sufficiently to meet an emergency of continued drought with a supply of artesian water adequate for the whole city, Dallas appears better off from a standpoint of water than at any other time in its history as a city. It is now nearly four years since Dallas first realized she was face to face with a serious water problem, and it has been the policy of the city commissions to work toward permanent and final solution of the problem. With more than 2,000,000,000 gallons of water in four immense reservoirs and with an artesian supply capable of being raised to more than 6,000,000 gallons per day by bringing into play all emergency sources, the contingency of a shortage of water such as to demand cutting off of the supply during most of the hours of the day seems hard to imagine until the city has far outstripped its present proportions.

### Breaking of Pump Limits Water Supply

North Tonawanda, N. Y.—The large 6,000,000-gallon pump at the water works station has broken down. As a result the water supply will be limited for about three weeks. The crippling of the water works means that in case of fire or other emergencies the city of Lockport will be called upon to help North Tonawanda's water works in furnishing a sufficient supply of water. The Lockport water system and the North Tonawanda systems are connected at Wheatfield street, and Lockport's system can become a part of the local system by the mere opening of a valve. Arrangements have been made with Lockport officials to cut in the Lockport service at any time the fire whistle is sounded. Three hours after the pump broke down a fire call was sent in, but before the Lockport system could be cut in the fire had been extinguished by the use of chemicals.

### Increase in Revenues of City Water System

Knoxville, Tenn.—The monthly report of the Knoxville water plant shows an increase of \$2,263.18 in the receipts for the month of April, 1912, over April, 1911, and a decrease of \$1,536.96 in disbursements. The water plant had in the bank to its credit on May 1 the sum of \$25,603.28. Geo. P. McTeer, Commissioner of Public Buildings and Parks, who has charge of the water plant, submitted the following financial statement of the plant to the commissioners for the month of April, 1912:

Receipts.	
Water rents, flat rates.....	\$11,845.38
Water rents, meter rates.....	8,554.20
Meter rentals.....	797.75
Off and on account.....	11.00
New services.....	676.98
Total receipts for month of April, 1912.....	\$22,697.79
Balance on hand April 1, 1912.....	8,181.53
Total.....	\$30,879.62
Disbursements for month.....	5,276.34
Balance.....	\$25,603.28
Receipts for April, 1912.....	22,697.79
Receipts for April, 1911.....	20,434.61
Increase.....	\$2,263.18
Disbursements for April, 1911.....	6,813.30
Disbursements for April, 1912.....	5,276.34
Decrease.....	\$1,536.96

### Filter Plant Needs Repairing

Kingston, N. Y.—Superintendent J. H. Harrison has submitted a report to the Board of Water Commissioners calling their attention to needed repairs, as follows:

"I beg to report that the condition of the alum tanks at the filter plant needs immediate attention. They have been repaired from time to time, awaiting the conclusion of the board's plans to improve the filter condition, but in my opinion it would be unwise to allow them to go longer, and I also consider it inadvisable to spend any money on them for repairs, and therefore recommend that two new tanks be purchased to take the place of the broken ones. Of course, if the board's plans had been carried out it would have been unnecessary to spend any more money on these tanks.

"The five-year period for thorough cleaning of the filter beds has also expired, and the filters should be renovated and thoroughly cleaned. It will require some additional labor to accomplish this, and I would request and recommend that the Superintendent be instructed to proceed with the work at once. While this work is going on it will be necessary to temporarily disconnect two of the filters at a time from the regular service. It is very unfortunate that this should be done, as we require all our filter service every day, and the installation of the new filters would have been a great help during this cleaning process, but the work should not be longer delayed."

## STREET LIGHTING AND POWER

### Lighting Company Installing Conduits

Rochester, N. Y.—Supplementing their policy of replacing the street overhead wires of the city with underground conduits and rear line concrete service poles, the Rochester Railway & Light Co. is beginning work on its Monroe avenue system. A conduit is already laid some distance out the avenue close to the city line. The company will now extend that conduit to the city line and plant their rear line poles similar to those being installed in Arnett street. The work will be finished in three weeks. That particular section of the city is one of Rochester's beauty spots. Cobb's Hill reservoir on one side and the beautiful buildings of the Orphan Asylum on the other side of the road make it one of the city's most beautiful entrances. When the street overhead wires have been eliminated the attractiveness of this section should be more enhanced.

### Saves Money by Ordering Definite Quantities

Philadelphia, Pa.—By a change in the method of purchasing supplies for the Electrical Bureau, Chief Pike has effected a saving of 25 per cent. The total saving for the year will depend upon the quantity of supplies purchased. In one item, however, there was a saving of \$1,000. The materials involved are those used for construction and repairs. Instead of awarding a contract for the year he received his bids in definite quantities of goods which will be needed, and which he will purchase and call for delivery at once. This plan permitted competition and resulted in a 25 per cent. reduction in the prices.

### Village Would Oust Light Company

Sebewaing, Mich.—Recently the village council passed a resolution ordering the Sebewaing Electric Company to remove its electric wires, poles, etc., from the streets of the village within 30 days. The position of the electric company is now made apparent by the serving of injunction papers on the members of the council restraining that body from taking any action to remove the poles and wires themselves. In 1901 the mercantile firm of John C. Liken & Co. was given a 10-year franchise for lighting the streets of the village and doing a commercial lighting business. Last spring the people of the village voted to erect a municipal lighting plant and the village was bonded for \$10,000 for that purpose. In August of last year those members of the firm of J. C. Liken & Co. interested in the lighting plant organized and incorporated. This was two months before the franchise expired. They now maintain they have a right to do a commercial lighting business by virtue of their being organized as a lighting company.



## FIRE AND POLICE

### New Fire Station in Commission

Haverhill, Mass.—Haverhill's new fire station, the ward 6 house, has gone into commission and Engine and Hose 6 are now stationed there. The ward 6 station was built three years ago by authority of the city council and since its completion has been held in reserve, the decision to equip it being reached last year, although this was delayed until last week by reason of new apparatus being required, as well as alterations at the station. The board of fire engineers recommended an increase in the number of permanent men and the municipal council granted it, three men being added to the department's fighting force



Courtesy Haverhill Gazette.

NEW WARD 6 ENGINE HOUSE.

and detailed to ward 6. District Chief John B. Currier has been assigned to the district and a company of sufficient size to man the apparatus has been detailed from Hose 3 and Ladder 1, and ward 6 now has protection against fire that was never before afforded.

### Fire Chief's Purchasing System Saves City's Money

Kalamazoo, Mich.—The recent acquisition by Fire Chief Russell of two of the latest model fire nozzles at a lower figure apiece than was paid by the city of Cleveland in buying a lot of fifty is an apt illustration of the method of purchasing employed by that official, which has resulted in the saving of thousands of dollars to the city annually since he received his appointment. The nozzles, which are of a model for which the chief has been searching for years, cost the city of Cleveland \$25 each for fifty. Kalamazoo bought two for \$43. Chief Russell insists on buying all supplies in wholesale lots at jobbers' prices and securing hay and grain at a little lower than the lowest market prices. His penchant for forcing a bargain has resulted in the police and fire commission placing the entire responsibility for the purchase of supplies for his department in his hands. The commission's action has been justified by the fact that each year the chief has turned back a good-sized sum from his annual appropriation. Last year out of an appropriation of \$51,000 he saved the city \$4,000, taking care of a \$1,600 increase in salaries and handing the commission \$2,400 in cash. The handling of all supplies is also done systematically. Each year Chief Russell secures a complete stock of what supplies will be needed until the next appropriation is received. As each tool or bit of apparatus is issued to the captains of the various companies it is promptly inventoried, and when any stock already in use is removed from one station to another a complete record is kept. In this manner the chief is able at all times to account for all departmental supplies. The expenses of the fire department have also been appreciably diminished by the fact that all repair work and building is done by its members, practically all of whom are skilled tradesmen. Electricians, machinists, blacksmiths, carpenters, masons, concrete workers, etc., are included in the men now forming the roster of the department.

### Novel Door Plates Invented by Firemen

Atlanta, Ga.—A simple device known as an "emergency door plate" has been invented and patented by W. O. Parker and Harold Cummings, two city firemen at fire headquarters. This plate is for the convenience of both patrolmen and firemen should a man's property in the city be burglarized or burn during the night, or any other accident happen to the place. It has the telephone numbers and addresses of whom to call and notify of the accident. Printed in bold letters are the words "burglary, fire, accident," and then appear the addresses and phone numbers. The cardboards are about 10 inches long and neatly framed, and are to be attached at the entrance of buildings. The young men have applied to Washington for a patent and are already protected in Georgia.

### Public Test for Pipe Line System

Baltimore, Md.—President Richard H. Johns, of the fire board, and Consulting Engineer Daniel B. Banks, under whose supervision the high-pressure pipe line system has been constructed, will hold a conference some time next week to decide upon the date of the first public demonstration of the system. The demonstration will be held on the court house plaza. The pipe line system and the South street pumping station are completed, and at a private demonstration several weeks ago, at which the fire commissioners were the only witnesses, the system worked perfectly. The demonstration next week will be witnessed by the mayor and other public officials, and Engineer Banks will formally turn the system over to the city. Baltimore's high-pressure pipe line system is said to be the best of those which have been installed in the principal cities of the country. The three pumps which operated the system, two of which will be kept going night and day, are capable of sending forth a wall of water adequate to combat the fiercest of fires in the business section.

### New Fire Alarm Apparatus in Use

Syracuse, N. Y.—A portion of the new central office fire alarm apparatus was put into service. The repeater from the old system was transferred to the rooms occupied by the new without breaking a single circuit or leaving one of the fire alarm boxes out of connection with the central office. At any time during the change an alarm could have been received and recorded. This was made possible by first putting in connecting wires between the two systems so that the new batteries took the place of the old. When the repeater was set up in the new quarters it was supplied with the new batteries. From now on Superintendent Edward Shannan and the operators at the central office will be in the new quarters. The old apparatus will be dismantled and the rooms it occupied used for offices. The entire central office plant cannot be put into use until the outside wiring is reconstructed and additional circuits installed.

### Will Install Electric Police Alarms

Freeport, L. I.—Chief of Police and President James Hanse have adopted the city system of "central telephone service" for use in the local police department, and it will be put into effect as soon as the chief can arrange matters with the telephone company. The new system will be a signal service capable of summoning the police from any part of the village. A monitor telephone board will be installed at police headquarters and a direct line will connect with the Freeport telephone exchange. There will be eight police signals in the village, four at the extreme compass points of the village and four centrally located easterly, westerly, southerly and northerly. Private wires for police use only will terminate in the central switchboard, and these will branch out to the eight points. The district telephones will be enclosed in iron or hardwood boxes on poles. The patrolmen on duty at night can, by means of a magnet signal, call headquarters and obtain instant aid from any of the eight stations. As part of this system will be a series of red lights which can be lighted from a single switch the patrolman can see and learn of urgent calls from any of these. The patrolmen will be required to keep in close touch with any and all of these stations, and the monitor at the telephone exchange will be on the qui vive to tell the inquiring policeman the reason for the red light signal.

### AUTO APPARATUS NOTES

#### Manchester Gets First Auto Engine in New Hampshire— Boston Will Purchase Ladder Trucks and Combination Wagons—Baltimore County Department Is Strengthened.

Richmond, Ind.—The new auto combination ladder and chemical truck recently added to the fire department has been given a number of trial runs and given satisfaction to Chief Miller and the city officials.

Milwaukee, Wis.—The fire department has added a second piece of motor-driven fire apparatus to its equipment. This latest addition is a Stegeman car, built on a truck chassis for the Board of Fire Underwriters. On account of the severe service the car will have in hill climbing, a heavy construction has been selected. This construction differs from the standard Stegeman in that underslung springs are used to lower the center of gravity and make the car more safe, and in the distribution of weight to give a very large percentage over the rear wheels.

Hartford, Conn.—Hose and Ladder Company No. 1 of the South Manchester Fire Department, at its monthly meeting, voted to purchase a combination hose and chemical automobile and a tractor with which to draw the hook and ladder apparatus. The officers of the company have been inspecting fire-fighting apparatus of this kind for some time, and L. N. Heebner, foreman of the company, was largely instrumental in bringing about the action. The addition of the new apparatus to the present fire-fighting equipment of this company will give Manchester superior fire-fighting facilities. The choice of machines was left in the hands of the following committee: L. N. Heebner, Capt. Philip Cheney, Adam Schieldge, Horace B. Cheney, L. H. Geer and Clifford Cheney. The company will not ask the district to assist in meeting the expense, but will assume the burden itself.

Manchester, N. H.—The city's fire protection has been reinforced by a gasoline fire engine, the first that was ever seen in the State, which was housed at the central fire station to take the place of the flying squadron, which has been out of commission for several days. When the demonstrators of the engine learned that the squadron was out of commission, they made an offer to the city to put their machine on call in case of fire. This offer the fire chiefs gladly accepted. The engine was tried out on Vine street and its behavior was watched with interest by the city's fire apparatus experts and won the approbation of practically all. It is a piece of fire-fighting apparatus that serves the same purpose as an ordinary steam fire engine, except that this is run by gasoline power and is an automobile. It was tried out in throwing streams of water from nozzles of various sizes and numbers. It threw water about 20 feet over the flagstaff on the central station, and about 50 feet over the trees on Concord common, drawing the water from the hydrant at Amherst and Vine streets. This gasoline fire engine is made by the Webb Motor Fire Apparatus Company, of St. Louis. It is being taken on a tour by representatives of the company into the eastern States and came here over the roads from Nashua in thirty-five minutes. Nashua is thinking of buying one, its fire officials having seen its workings. When in full action it pumps about 600 gallons of water a minute. Its gasoline engine has 94 horsepower, and the same engine propels the vehicle and pumps the water, the engine's action being transferred from its one function to the other by the simple reversing of a clutch. One advantage over a steamer is that it has no smoke, which in time of fire sometimes sets other fires with the sparks mixed in with it and beclouds the air. Another advantage is that it sets more solidly and needs no stoker. Among those who saw the demonstration were the fire chiefs and Aldermen Albert L. Clough and William M. Morgan. Among the men who were traveling with the engine are Fire Chief George F. Whitney, of Nashua; former Alderman Charles Murray, of Nashua; Fire Commissioners Minot Barnard and George D. Dryden, of Melrose, Mass.; Frederic E. Treffery, a master mechanic and representative of the New York office of the Webb company; W. E. Potter and James Birmingham, of the Boston office, and S. Hadley Mitchell, of St. Louis.

Salt Lake City, Utah.—The new combination fire automobile, "Samuel C. Park," was given a speed trial one night last week between fire headquarters and the State penitentiary. It covered the distance of six miles in seven minutes. Fire Chief W. H. Bywater was on board the machine while the speed test was made.

South Bend, Ind.—The new runabout automobile recently purchased by the board of public safety for Fire Chief Wilferd Grant is expected to arrive in the city within the week and will be placed in commission as soon as the finishing work has been completed. This will be done at the plant of the Studebaker corporation. It is expected the work will be completed in about thirty days. At a meeting of the safety board arrangements were made for putting the car in the service as soon as it is ready. The machine is a standard E. M. F. model "30" and was purchased from the Studebaker company for \$1,528. It has already been shipped from the automobile factory at Detroit to this city, where the body of the machine will be repainted and other details of the specifications are fulfilled to the satisfaction of the board. The machine will be painted an orange red to conform with the motor chemical truck.

Catonsville, Md.—Since the inauguration, several months ago, of automobile service in the fire department at Catonsville, the efficiency of the service in that suburb has been greatly increased and the big motor car has proven its superiority over the slower horse-drawn apparatus many times. The Catonsville Fire Department claims that their automobile is the fastest in the State. It is a combined chemical and pumping engine, and was built by the American-La France Fire Engine Company. The car is of the four-cylinder, 70-horsepower type and is capable of running sixty-five miles an hour. The same power used to run the engine operates its pumps. The car is equipped with 1,200 feet 2½-inch hose, 20 feet 5-inch suction hose, a 40-gallon chemical tank, 200 feet 1-inch chemical hose, three extinguishers and two ladders. The engine was secured by the Catonsville department largely through the efforts of Dr. Charles Mattfeldt, the president of the Board of County Commissioners of Baltimore County, who lives at Catonsville. This auto is now several months old and a larger and more costly motor will soon replace this one, which will be transferred to Gardenville.

Baltimore, Md.—With the addition of four auto trucks within the next month, the Baltimore County Fire Department will come up from a poorly equipped fighting organization to a rank with the best county departments in the State. It is the intention of the county commissioners to displace all the old horse-drawn wagons with auto engines. The changes will be made in the following companies on June 1: Pikesville, Arlington, Gardenville and an auto hook and ladder truck at Roland Park. Arlington and Pikesville will have new trucks, their horse apparatus being sent to the upper part of the county, which is protected by volunteers. It is understood that paid companies will be installed in those places. Roland Park, at the expense of the residents, is equipping the engine house with a hose-drying apparatus, which, when completed, will cost about \$600. With seven auto engines throughout the eastern, northern and western parts of the county and two steamers in Highlandtown and Canton, Commissioner Mann says the county is well equipped and ready for business. Towson and Grovers will be the next towns to receive autos.

Boston, Mass.—The city council having authorized the expenditure of \$50,000 for the purchase of motor fire apparatus, accepted the invitation of the fire commissioner one day recently and went to Springfield to inspect apparatus. It is the plan of the commissioner to purchase three new motor ladder trucks, three motor combination hose and chemical engines and a number of automobiles for the district chiefs in the outlying districts.

Rochester, N. Y.—The new automobile combination chemical and hose wagon, which was put in the fire service May 1, at the Platt street fire house, is proving such a success that it is quite probable that as soon as it is feasible more of the automobile apparatus will be purchased by the city. Chief Little said that the new auto fire wagon had responded to seven or eight alarms since it was put in use and more of the automobile apparatus will be purchased by alarm.



**GOVERNMENT AND FINANCE****Threatens to Force Passage of Appropriation Ordinance**

Pittsburgh, Pa.—City Treasurer James A. Fulton, of McKeesport, threatens to take the City Councilmen into court if they refuse to pass the appropriation ordinance before next pay day. The city employes cannot be paid until the measure is passed. Some of the heads of the departments are paying the employes out of their own pockets, accepting due bills and vouchers in exchange. Council refuses to pass the measure until some of the items are struck out.

**Municipal Ownership Plans in Cleveland**

Cleveland, O.—Municipal ownership of street railways, telephones and ice plants, public control of Cleveland's entire lake front and the establishment of a city market department that would have the power to regulate food prices—all these things, in the opinion of members of the City Council, should follow the establishment of home rule in Cleveland. Action taken recently by delegates to the constitutional convention at Columbus permits Ohio people to vote on an amendment to the constitution permitting city home rule. Councilmen French and Pelcinski expressed themselves in favor municipal ownership of street railways first of all. They believe a municipal telephone system should come next, and in their opinion the city should use home rule power to establish municipal ice plants. Councilman Menning believes that control of food prices should come first. It is also his belief that the city should take steps for public control of the entire lake front. The food and harbor questions are of vital importance to the people at this time, he believes. Mayor Baker expressed the belief that this was not the time to state what would be done if home rule is obtained. "First let us get the power," he said. "I'm delighted with the outcome of the home rule work at Columbus. Cleveland will be in a position to make history if the amendment is approved."

**To Itemize Street Improvement Accounts**

Haverhill, Mass.—A new plan of accounting for street work will be put into operation at once, according to Alderman Wood and City Auditor Leach. Under previous plans the street work has been bunched by jobs so that a stretch of macadam might appear to have cost a certain sum of money, when as a matter of fact some of the money had been spent for grading, some for culverts, and some for other kinds of street work which was certainly not macadam. The Aldermen have transmitted an order for the keeping separate of these accounts, and the auditor has agreed to separate them, too, so that it will be possible to estimate the exact expense of macadamizing a street hereafter, and it is believed that the plan will be of big benefit, the only requirement being a new set of books for the departments, with spaces for the different branches of the work.

**Mayor Wants Rent for Sidewalk Space**

Schenectady, N. Y.—What may prove to be a new source of revenue to the city was discovered by Mayor George R. Lunn while passing along a downtown street. Digging for the foundations of a new building was in progress, and the excavations had been carried under the sidewalk to about the curb line, with the evident intention of using this space thus obtained for a cellar vault, probably to hold coal. The owner of the property was standing near, and he fell into conversation with the Mayor. Before the two parted the Mayor had evolved the question whether or not the city should be paid for the use of the ground under the sidewalk as a cellar. Later Mayor Lunn said he would have the matter looked up to ascertain if all such cellars, present and future, could not be made to pay a rental to the city, as the real owner of the ground in which they are made. He said the question with him was yet in an entirely speculative stage, but if it were decided in favor of the city he would seek legislation authorizing the collection of such rentals.

**Commission to Rule Atlantic City**

Atlantic City, N. J.—Commission form of government was adopted here May 14 by a majority estimated at 400 votes.

**STREET CLEANING AND REFUSE****Walks Must Be Sprinkled**

Fort Worth, Tex.—The city Health Department has given out instructions to the effect that the State law requiring sidewalks to be sprinkled with water before sweeping will be enforced. Health Office Bender states that dust is one of the most effective agents in spreading disease, and that precaution must be taken during the summer to prevent the endangering of health.

**Uniformed Squad Cleans City**

Dallas, Tex.—Following out plans made by Street Commissioner Lee and Street Superintendent Ben Sira, street sweepers of the city of Dallas have made a changed appearance in the few days since the first of the month, going about their work in neat khaki uniforms of jumper and overalls with a helmet to match. The regular men are all being provided with these suits, and it is planned to get suits also for the extra men as rapidly as possible. Street Superintendent Sira said that the street cleaning force will make special efforts to be prepared for the coming of the advertising convention, now little more than two weeks off. He says that, although the downtown streets are now kept pretty clean, extra men will be put on during the convention and the streets will be kept as spotless and dustless as possible. Also upon the days when parades will be made extra men will be at work upon the streets over which visitors will pass, and those, too, will be kept spick and span. Since the water supply has been plentiful Superintendent Sira has had men at work every other night flushing off the paved streets and washing out gutters and storm sewers.

**Garbage Removal Reforms**

New York, N. Y.—The Committee on Streets of the Woman's Municipal League has sent to the Board of Estimate suggestions for improving the method of collecting ashes and garbage. The committee wants the city to plan a standard receptacle capable of being tightly sealed for all ashes and garbage, and require each owner to have duplicates of these receptacles. The city should have automobiles to collect the receptacles, should empty and wash them, and return them to their owners, the committee thinks. In support of the suggestions the committee says: "The cost to the city would in fact be less. The men would not be called upon to empty cans into wagons and then wagons into scows. The sealed receptacles could be transported direct to incinerating or destructor plants, either by automobile trucks, subway, surface cars, or, ultimately, perhaps, through subway tubes of size adapted to the receptacles. We have stopped surface drainage in our cities; is it not about time we stopped open collection of garbage and ashes? We are concerned, of course, with the side of the question involving the city's health. Sealed receptacles would mean less dirty streets, less dirty gowns, and less germs floating around. We are concerned also with the cleanliness of the city. Every time ashes or garbage is collected by emptying open receptacles into open wagons we duplicate the work of cleaning the streets. We think a little 'scientific management' applied to the collection and distribution of ashes and garbage would result in a more efficient street cleaning system. Even if the entire plant here suggested may not be immediately workable, certainly substitution of automobile vehicles for our present toy carts is something to be thought of immediately. We think the needs of the Street Cleaning Department should be treated in the same progressive way as the city is treating the needs of the Fire Department."

**RAPID TRANSIT****Municipal Railroad to Park Proposed**

Pittsburgh, Pa.—The question of having a trolley line in Schenley Park, to make it more accessible to the public, has been discussed by a committee of Council and will soon be brought to the attention of the Public Service Committee. A plan for the line was presented by Superintendent W. E. Geiston, of the Bureau of Surveys. He said that the line would have to be about three and one-half miles long.

## LEGAL NEWS

### A Summary and Notes of Recent Decisions—Rulings of Interest to Municipalities

#### Contract for Water Plant—Deductions

Mayor and Aldermen of Jersey City vs. Jersey City Water Supply Co. et al.—A water company's contract to deliver to a city a completed operating plant, free from pollution, and a provision that the operation of sewers and sewage disposal works should not be a charge against the city, do not entitle the city to deduct from the contract price the capitalized cost of operating a device for removing dangerous germs from the water.—Court of Errors and Appeals of New Jersey, 82 A. R., 732.

#### Board of Public Works—Authority

City of Union v. Sartor et al.—Civ. Code 1902 provides that cities may construct and operate city water works and electric light works; that the city council shall call elections to vote bonds to meet the cost of the same, and shall turn the bonds over to the board of public works; that the board of public works shall be elected and have power to sue and be sued, and to construct and operate and fully control and manage such works, and that it shall be its duty to furnish light and water to citizens and the city, and to exact payment and to make monthly statements to the city council of receipts and disbursements, but have no power to incur indebtedness without the concurrence of the council; that the city council may levy taxes, pay interest on the bonds, and create a sinking fund under the control of the board; that cities may procure locations and facilities for such works, and may furnish water and lights to individuals, firms and private corporations for reasonable compensation. Const. provides that cities may acquire such works upon a majority vote of the citizens authorizing an indebtedness therefor. Held, that a demurrer to a complaint by a city to restrain its board of public works from cutting off water and electric lights from the city on account of the refusal of the council to pay charges, arbitrarily fixed by the board, the amount of which was in dispute between the board and the council, was improperly sustained; it being the duty of the board to resort to the courts to determine the reasonableness of the charges.—Supreme Court of South Carolina, 74 S. E. R., 496.

#### Street Paving Contract—Notice to Repair

Asphalt Paving and Contracting Company vs. City of New York.—A paving contract between a city and a corporation required the contractor to keep the pavement in repair for fifteen years from its completion, and provided that notice to make repairs should be served on the contractor either personally, or by leaving it at its residence or with its agent in charge of the work. Before the expiration of the fifteen years the corporation was dissolved and another paving company was appointed its agent to keep the pavement in repair, so that the original company might collect the entire contract price, part of which had been retained by the city as security. Held, that written notice to the agent demanding that it, as a principal, repair the pavement, and not specifying that its liability was because of its agency, was insufficient to put the contractor in default, it not appearing that either the contractor or the agent misled the city officials into believing that the agent was the assignee or successor in interest of the original contractor, and hence the city could not deduct the cost of repairs made by it from the amount due the contractor. After the voluntary dissolution of a paving company to which a city was indebted, its vice-president, with the consent of the directors, executed under seal an assignment of its rights against the city to another. Held, that such assignment, being under seal and under the order of the directors, was valid, for Stock Corporation Law as amended and re-enacted in General Corporation Law, which was in force at the time of the dissolution, provides that a dissolved corporation shall nevertheless continue in existence for the purpose of collecting its assets, and may sue and be sued for the purpose of enforcing such debts or obligations until its affairs are fully adjusted.—New York Supreme Court, 134, N. Y. S., 433.

#### Bridges—Defects—Liability

Johnson v. City of Eau Claire.—Where a bridge in a city street was defective, in that a three-inch plank was nailed to the floor and extended about three inches above the floor diagonally across the bridge, so that, when a team was driven across the same the front wheels of the wagon would not strike the plank at the same time, which resulted in the death of a traveler passing over the bridge, such defect was prima facie an insufficiency or want of repair within St. 1898, Sec. 1339, providing that a city shall be liable for injuries caused by the insufficiency or want of repair of a highway or bridge.—Supreme Court of Wisconsin, 135 N. W. R., 481.

#### Electric Franchise—Impairment

Saginaw Power Co. vs. City of Saginaw et al.—At the time of the sale the selling company operated the only electric plant in the city, and the purchasing company had only its franchise, under which it thereafter operated the plant purchased, but at reduced rates to consumers fixed by its charter. Its charter was not exclusive. Held, that there was nothing in such facts to make it an illegal monopoly, and that a resolution of the city council ordering a removal of its poles, conduits and wires from the streets was unauthorized and void as depriving it of its property without due process of law and an impairment of the contract made by the ordinance granting its franchise.—United States Circuit Court, 193 F. R., 1008.

#### Water Supply—Filters—Maintenance

Coykendall vs. Harrison et al., Board of Water Commissioners.—The Kingston city charter created a board of water commissioners, with power, with the consent of the common council, to construct and maintain a water works system. Section 98 provided that the moneys derived therefrom should be applied to the payment of the cost of maintaining, operating and extending the water works, and to the payment of principal and interest on bonds as they fall due. The board, by Section 99, was given power to keep the system in operation independent of the city council, and to fix and collect water rates, and make and enforce rules and regulations. By Section 101 the moneys derived from water rates and penalties were required to be paid to the city treasurer, to be credited to the water fund and applied to the payment of expenses of ordinary maintenance and management, the balance, if any, to the payment of principal and interest on bonds, and any surplus still remaining to be used for any lawful city purpose. Held, that additional filters, requiring an expenditure of \$16,235, was not an ordinary "maintenance" expense, and that the board had no power to incur such expense without the consent of the city council.—New York Supreme Court, 134 N. Y. S., 447.

#### Street Improvements—Assessments—Deficit

City of Beaumont vs. Masterson.—Where a city took proceedings to improve a street, the cost to be paid, two-thirds from assessments on abutting property and one-third by city bonds, that a part of the assessments levied were uncollectible did not require that the city foresee such event, and treat the uncollectible portion as a debt, within Const. 5, providing that no debt shall ever be created by any city, unless at the same time provision is made to assess and annually collect a sufficient sum to pay the interest thereon and create a sinking fund of at least 2 per cent.—Court of Civil Appeals of Texas.

#### Paving Improvements—Taxpayer's Action

Jensen vs. Board of Contract and Supply of City of Schenectady et al.—Where a city charter provides that the streets shall be paved with only cobble stone, broken stone, or gravel, except on petition of owners constituting one-fourth of the frontage, and two separate petitions, one for paving the street beyond the pavement already laid, with asphalt, and the other for paving the same street with sheet asphalt or bitulithic pavement, were filed, and bids received for paving the whole with such bitulithic pavement, in a taxpayer's action to restrain the city from contracting with the successful bidder, the latter is a necessary party.—New York Supreme Court, 134 N. Y. S. 630.



## NEWS OF THE SOCIETIES

### Third International Road Congress

The congress will open June 23 of next year and will last for six days. The exhibition of appliances will be held in the Royal Horticultural Hall. As space is limited, manufacturers are advised to apply early; the application may be withdrawn later. The proceedings will be as follows:

Programme of Questions at the Congress.

First Section—Construction and Maintenance.

Sub-section A.—Construction and Maintenance of Roads Outside Towns.

Sub-section B.—Construction and Maintenance of Roads in Towns.

Sub-sections A and B sitting together.—Questions common to both.

Second Section—Traffic and Administration.

Sub-section C.—Traffic and vehicles. Sub-section D.—Administration, Finance and Statistics.

Sub-sections C and D sitting together.—Questions common to both.

First Section—Construction and Maintenance.

Questions common to sub-sections A and B.

First Question—Planning of New Street and Roads.

(a) Old towns: 1, in central districts; 2, in the suburbs.

(b) In new towns.

(c) In the rural areas.

Importance of directness of route—Alignment—Longitudinal and cross-sections—Curves—Analysis of practical and economic value of width under various circumstances—Steps necessary to insure the security of and regularity of the various currents of circulation—Whether local or through traffic—Reconciliation of requirements of each of the former—By-pass roads avoiding towns and villages—Treatment of crossings and corners—Arrangement of metalled carriageways, footpaths, special tracks, taking into account the presence or absence of tramways, of bicyclists, and of the various methods of circulation generally in use.

Second Question—Types of Surfacing to be adopted on Bridges, Viaducts, etc. (fixed or movable bridges, suspension bridges, railway bridges).

Cost—Wear—Durability of various surfacings—Methods of maintenance and repair, of remaking.

Communications common to sub-sections A and B.

Communication 1—Improvements adopted since the Second Congress in Machinery used in the Construction and Maintenance of Macadamized Roads.

Sweepers—Water carts—Machine rammers—Light rollers—Mixers—Stone driers and heaters—Transport wagons.

Communication 2—Tests of Materials used in the Construction of Macadamized Roads.

Laboratory and practical tests—Testing machines and appliances—Comparative value of various tests—Statistics of results obtained.

Second Section—Traffic and Administration.

Questions in common to sub-sections C and D.

Fifth Question—Methods of Lighting.

(a) The public highway.  
(b) Vehicles.

Sub-section C.

Sixth Question—Observations Noted since 1908 as to the Various Causes of Wear and of Deterioration of Roadways.

1. In towns.

2. In suburban districts.

3. In open country.

Effects produced by sun, frost, snow, or any variations of temperature—Effects due to the circulation of self-propelled and horse-drawn vehicles—Mixture of fast and slow traffic, aggregate volume and density in busy hours—Effect of speed, weight, construction, position of the exhaust, width and diameter of wheels, various kinds of tires, shoeing of horses.

Seventh Question—Regulations for Fast and Slow Traffic on Roads.

Conditions to be observed with a view to the safety of the public—Precautions to be taken during progress of repairs—Regulations for the use of the roads during frost and thaw—Positions of lamp-posts and other obstructions.

Communication 6—Direction and Distance Sign-posts.

Communication 7—Development since the Second Congress of Self-Propelled Public Service Vehicles.

Dimensions—Weight—Capacity—Cost of Upkeep—Mileage worked.

Sub-section D.

Eighth Question—Authorities in Charge of the Construction and Maintenance of Roads, Functions of Central Authorities and Local Authorities.

Advantages and disadvantages of centralization and decentralization—Area and organization for construction, maintenance, repairs—Staff employed, its composition, and whence drawn—Systems of inspection.

Ninth Question—Finance of the Construction and Upkeep of Roads—Provision of Revenues.

Special taxes—On what classes of persons, vehicles or objects would the taxes weigh, bases on which the incidence of taxation should be founded?—Borrowing for road construction and renewals—Methods of repayment.

Communication 8—Qualifications of Engineers and Surveyors in Charge of the Construction and Maintenance of Roads—Wages and Conditions of Service of Foremen and Roadmen.

Communication 9—Statistics of Cost of Construction and Maintenance.

Methods of keeping accounts—Repatriation among the various authorities, boards, etc., interested—Comparative statistics per unit of population, mileage, traffic, etc.

Communication 10—Terminology Adopted or to be Adopted in each Country relating to Road Construction and Maintenance.

The Road Exhibition.

The exhibition is open to all classes of machinery, apparatus, models, drawings, plans and maps which are illustrative of road construction.

First Class—Machinery and Tools.—The Machinery and Tools class will be divided into two sections—(1) Materials; (2) Machinery and Tools.—The first of which will include samples of stone broken and chipped, tars and pitches, bitumen and asphalt, various surfaces, and testing apparatus; and the second, rollers, steam dryers, tar-mac-

adam mixers, breakers, scarifiers, tarring and pitch grouting apparatus, asphaltting apparatus, carts, tools and various apparatus, and cleansing and watering apparatus.

Second Class—Traffic.—This will be divided into three sections—(1) Mechanical road traction (2) horse traction; (3) highway and vehicle illumination. The first of these will include vehicles for the transport of road materials, wheels and tires designed to carry heavy weights without damage to the roads, non-skid apparatus not damaging to roads, and light railway and tramway tracks; the second, wheels and tires, non-injurious horseshoes, and shoeing, with special reference to securing foothold; and the third, highway illumination (gas, oil, electric lamps and standards); vehicle illumination (front and rear lamps, head lights).

Third Class—Models, Maps, Drawings and Publications.—In this class the exhibits will include maps and plans, statistics, forms of accounts, acts, regulations and by-laws, meteorological records, information as to first cost and maintenance, traffic, etc., models of and monographs on road works, and publications.

Fourth Class—Historical.—Specimen sections of road construction, old and new, and historical exhibits will be accepted under this classification.

Sub-section A.

Third Question—Construction of Macadamized Roads bound with Tarry, Bituminous or Asphaltic Materials.

Which are the best methods and materials for the construction in open country of macadamized roads bound with tarry, bituminous or asphaltic materials?

Note.—Reports sent in under this heading must include all or some of the following heads, and furnish as much as possible data obtained from practical experience, and more especially on the results obtained in the various trials that have taken place since the Second Congress.

1. Foundations and drainage.
2. Sizes and shapes of broken stone for bituminous-bound surface crust.
3. Use of partially-worn materials in bituminous-bound surface crust.
4. Thickness and composition of the strength crust and of the super or wearing crust under different conditions.
5. Life of surface crust under different conditions of traffic, weather, sub-soil, etc.
6. Relative importance of patching, repairs, and periodical renewals of surface crust.
7. Extent of wear permissible before renewal of surface coating.
8. Measurement of wear and appliances used for this purpose.
9. Various methods of bituminous treatment:

(a) Mixing methods—(1) in factories; (2) on the spot.

(b) Grouting methods.

(c) Carpeting methods.

(d) Other methods.

10. Relative advantages and use of tar, tarry compounds, asphalt, bitumen and other materials.

11. Tests and chemical analysis of tarry, bituminous and asphaltic compounds.

12. Climatic effects causing slipperiness of the roadway—Remedies.

13. Effect on public health, fish life, or vegetation.

14. Specification of the methods of construction.

15. Cost data.

16. Cleansing and watering.

Communication 3—Construction of Water-bound Macadamized Roads.

Which are the best methods of construction and maintenance for water-bound macadamized roads used in country or suburban districts since the Second Congress?

Note.—Reports sent in under this heading must include all or some of the following heads, and furnish as far as possible data obtained from practical experience.

1. Foundations and drainage.

2. Choice of materials.

3. Sizes and shapes of broken stone and of chippings.

4. Use of partially worn materials in the formation of the surface crust.

5. Thickness and composition of the strength crust under different conditions.

6. Life of the surface crust under different conditions of traffic, subsoil, etc.

7. Relative importance of patching repairs and periodical renewals—Methods of resurfacing.

8. Specifications of the methods of construction.

9. Cost data.

10. Cleansing and watering.

Communication 4—Technical and Economic Study of the Comparative Advantages of Different Types of Roads.

[The names of the members of the sub-committee appointed to select the writer for this communication will be found in the "Personal" column in this issue.]

Under what circumstances and conditions of traffic are the following types of road preferable from the point of view of the traffic and from that of economy?

1. Stone setts.

2. Metaled roads, bound with tar, pitch, asphalt or bitumen by

(a) Mixing or grouting methods.

(b) Carpeting methods.

(c) Other methods.

3. Metaled roads—Water-bound.

Sub-section B.

Fourth Question—Wood Paving.

Choice of wood—Methods in use—

Resistance to wear—Methods of maintenance—Cost—Cleansing and watering.

Communication 5—Various Types of Stone Paving in Use.

Advantages of unification.

#### American Association for Highway Improvement

Picking out individual States, each in its turn, and covering them from end to end with local associations dedicated to the movement for the improvement of the public highways, is the method that is being pursued by the American Association for Highway Improvement in its campaign to co-ordinate and crystallize the road movement in the United States. Fred S. Smith, the special representative of the American Association for Highway Improvement, has just reported to J. E. Pennybacker, Jr., executive secretary of the association, that the State of Florida has been covered from end to end with local road improvement associations.

Mr. Smith has been traveling in Florida for the past twelve weeks and his results give a fair indication of what the American Association for Highway Improvement, which was formed by leading officials, railroad men, professional men and others for the purpose of establishing a clearing

house for the road movement, expects to accomplish in every state in the Union. In the twelve weeks in which Mr. Smith worked in Florida he covered 3,200 miles in an automobile, traversing 24 counties and 37 towns.

None of the representatives of the American Association are of the dilettante type, and in his trip Mr. Smith never hesitated to get down off the platform from which he was speaking in order to show the farmers just how to construct certain types of road. While Mr. Smith's work is largely along the lines of organization, he actually aided in the work of connecting the good roads of one county with those of another county, bringing the whole State into closer and quicker communication. Many miles of road were actually constructed as a result of Mr. Smith's tour of the State and he had an opportunity to witness some of the results of his own missionary work.

The representative of the American Association for Highway Improvement addressed sixty meetings in the various counties, in some of which bonds have since been issued for the purpose of investing in improved public highways, which Mr. Smith assured them was the best investment on earth. The American Association is now preparing for similar campaigns in Illinois, Ohio, Indiana and West Virginia. Meanwhile, Field Secretary Light is doing similar work in the Western States.

#### Southwestern Water Works Association

A convention of water works superintendents and city officials was held at Temple, Tex., May 7, and a permanent organization formed. The following officers were elected: President, Pat Brachen, Temple; T. J. Powell, Fort Worth; R. L. Johnson, Houston; H. L. McDuffie, Sherman; Thomas Cronan, Palestine; P. C. Bartholomew, Austin, were elected vice-presidents, and E. L. Fulkerson, Waco, secretary-treasurer. Representatives were present from Louisiana, Oklahoma and New Mexico. The first annual convention, the date of which will be announced later, will be held at Fort Worth.

#### American Water Works Association

The transportation committee of the Water Works Manufacturers' Association, W. H. Van Winkle, 15 Broad street, New York City, chairman, have made the following announcement of arrangements for transportation to the Louisville convention:

Arrangements have been made with the Pennsylvania railroad on special train leaving Pennsylvania Station, New York, 10.50 a. m., Sunday, June 2, to convey the delegates, arriving at Louisville 10.30 a. m. Monday, June 3, running on the following schedule:

June 2d, 1912:

Lv. New York, Pennsylvania Station	10:50 a. m.
New York, Hudson Terminal	10:50 "
Jersey City, N. J.	10:53 "
Manhattan Transfer	11:08 "
Newark, N. J.	11:11 "
Philadelphia, Broad St. Sta.	1:02 p. m.
Washington, D. C.	11:55 a. m.
Baltimore, Md.	1:05 p. m.
Baltimore, Md.	1:05 p. m.
Harrisburg, Pa.	3:35 "
Pittsburgh, Pa.	(Central time) 8:55 "

June 3d, 1912:

Lv. Indianapolis, Ind.	7:30 a. m.
Ar. Louisville, Ky.	10:30 "

If we are successful in securing 100 passengers a train de luxe will be furnished consisting of the most modern Pullman steel, vestibuled sleeping cars, club, dining and observation cars, and a passenger representative will accom-

pany the train to care for the details of the trip and for the comfort of the party.

In the event that there is not sufficient travel to warrant the operation of a special train, extra sleeping cars will be attached to regular trains for the accommodation of members. However, it is hoped that the majority of the members will find it convenient to travel together in order that the special train may be assured.

No special rate has been authorized as yet for this occasion. The individual fare between New York and Louisville is \$20.50; eastbound, \$19.10; and the party fare, ten or more persons traveling together on a block ticket, is \$17.30 per capita, in each direction. The charge for lower berth in sleeping car is \$5; upper berth, \$4; section, \$9; stateroom, \$14; drawing room, \$18, in each direction.

The same arrangement for return trip will be made if sufficient number can be secured, to leave on the following schedule:

Friday, June 7:

Lv. Louisville, Ky., Penn. Lines	3:00 p. m.
Ar. Indianapolis, Ind.	6:50 "
Lv. Indianapolis, Ind.	7:05 "

Saturday, June 8:

Ar. Pittsburgh, Pa. (Central time)	5:45 a. m.
Lv. Pittsburgh, P.R.R. (Eastern time)	7:05 "
Ar. Harrisburg	12:52 p. m.
Ar. Baltimore, Md.	3:20 "
Washington, D. C.	4:40 "
Ar. West Philadelphia	3:14 "
New York, Penn. station	5:30 "

T. C. Clifford, of the Pittsburgh Meter Co., East Pittsburgh, Pa., is arranging for special Pittsburgh car (if local applications warrant) to be attached to our special train at Pittsburgh.

You are earnestly solicited to accompany us as above arranged so that we may secure the fine accommodations incidental to 100 passengers. Parties contemplating taking this special train can secure reservations by communicating with Colin Studds, District Passenger Agent, Pennsylvania Railroad, 263 Fifth avenue, New York, and all who intend going are urged to write at once to Mr. Studds so that the committee may know at the earliest moment the number to provide for and secure full accommodations.

#### Maine Fire Chiefs' Association

The first meeting of the association since its organization in January was held in Augusta, May 9, twenty-seven chiefs being present. The meeting was called to order by Chief Flaherty, of Portland, who requested Chief Buckley, of Augusta, to preside. City Treasurer Niles N. Perkins, representing the mayor, extended the welcome of the city. E. C. Carll welcomed the members in behalf of the Board of Trade. Andrew P. Harvey, Sullivan, State insurance commissioner, spoke of fire risks in Maine. He commended Chief Flaherty of Portland for the inauguration of his system of inspection and cleaning up of rubbish in and about buildings which materially reduced the fire loss. He stated that the fire loss in Maine was altogether too large—\$9.92 per capita. Judge Benedict F. Maher suggested several laws needed to improve the efficiency of fire departments. Among them was a law putting departments on a civil service basis; another would make it compulsory for railroads to maintain a flatcar ready for the instant loading of fire apparatus; a third would provide for the investigation of the cause of fires by chiefs at the expense of the State. T. C. O'Hern, city electrician, Cambridge, Mass., made a



brief address. Several exhibitions of fire fighting equipment were made by the manufacturers. The D. Cornelius Callahan Company had a good line of their appliances on exhibition. A Callahan turret nozzle recently purchased by the city was given a trial on the river front, various size nozzles being used. The S. F. Haywood Company, New York, showed a smoke helmet with oxygen apparatus attached. The Gamewell Company, Boston, exhibited three of their latest successive fire alarm telegraph stations, together with the indicator that would be at the central station.

#### National Gas Engine Association

The association announces that in connection with its convention the first annual national gas engine show will be held in Milwaukee, Wis., June 17 to 22, inclusive. It will be held in the Auditorium, where about 100 exhibition spaces have been laid out, and will include everything in gas power and allied lines. Exhibits will not only comprise the stationary and heavy-duty type of engine, but also the small farm engine, the marine engine, the automobile engine, and possibly the aeronautic motor. Spaces will be allotted in the building to manufacturers of accessories. Space adjoining the building will provide an arena for tractor exhibits. Applications for space should be made to O. C. Parker, president of the association, La Crosse, Wis. Albert Stritmatter, Cincinnati, O., secretary of the association, announces that the programme for the meeting is now being arranged and that there will probably be sessions at which papers intended particularly for dealers and individual users will be prepared by men of high standing in the business.

#### American Society of Mechanical Engineers

Calvin W. Rice, secretary, announces that honorary membership in the society was conferred on Rudolph Diesel, D.E., D.Sc., director Verein Deutscher Ingenieure, inventor of the Diesel engine, on April 30, 1912, 8:15 p. m., in the auditorium of the Engineering Societies building, 29 West 39th street, New York City. The presentation was followed by an illustrated address by Dr. Diesel on "The Development of the Diesel Engine."

#### Wilmington Board of Trade

The distinction of holding the first Boulevard Dinner on record belongs to the Wilmington, Del., Board of Trade. On the evening of May 8, 200 citizens of Delaware and other States attended the annual dinner, at which the du Pont boulevard was the principal topic under discussion. The effect of the boulevard on small communities was discussed by Mayor Harrison W. Howell, of Wilmington; State Senator William C. Sproul, of Chester, Pa.; Walter B. Miller, of Salisbury, Md.; Thomas L. Cannon, of St. Louis, Mo., and others. Mr. Miller stated that he would buy farm land abutting on the boulevard for a distance of twelve miles along the western side of Sussex County, in order to assure a right of way, so confident is he that it will greatly enhance farm values. Senator Sproul, who is the author of the Sproul bill before the Pennsylvania Legislature, which would appropriate \$50,000,000 for road construction, stated that the authorities in Pennsylvania were already planning to build roads to connect with the du Pont boulevard.

### Calendar of Meetings

**May 14-17.**  
**National Fire Protection Association.**—Annual Meeting, Chicago, Ill.—F. H. Wentworth, Secretary, 87 Mill Street, Boston, Mass.

**May 16-18.**  
**Ohio Society of Mechanical, Electrical and Steam Engineers.**—Annual Meeting, Pittsburgh, Pa.—F. E. Sanborn, Secretary, Ohio State University, Columbus, O.

**May 16-19.**  
**National Good Roads Association.**—Convention, New Orleans, La.—Arthur C. Jackson, President, Chicago, Ill.

**May 27-29.**  
**Fourth National Conference on City Planning.**—Meeting, Public Library, Boston, Mass.—Flavel Shurtleff, Secretary, 19 Congress Street, Boston, Mass.

**May 28-31.**  
**American Society of Mechanical Engineers.**—Special Meeting, Cleveland, O.—C. W. Rice, Secretary, 29 W. 39th Street, New York City.

**June 3-8.**  
**American Water Works Association.**—Annual Convention, Louisville, Ky.—John M. Diven, Secretary, Troy, N. Y.

**June 4-6.**  
**Michigan State Firemen's Association.**—Thirty-eighth Annual Convention, Kalamazoo, Mich.—A. P. Lane, Secretary, Ithaca, Mich.

**June 11-12.**  
**Police Chiefs and City Marshals' Association of Texas.**—Convention, San Angelo, Tex.

**June 10-12.**  
**Mayors Conference of New York.**—Third Annual Meeting, Utica, June 10-12.—Mayor C. C. Duryee, President, Schenectady, N. Y.—Wm. P. Capes, Secretary, New York.

**June 10-14.**  
**National Electric Light Association.**—Annual Meeting, Seattle, Wash.—T. C. Martin, Secretary, 29 West 39th street, New York City.

**June 12-14.**  
**Maryland State Firemen's Association.**—Twentieth Annual Convention.—Edward Stevenson, Secretary, Lonaconing, Md.

**June 17-22.**  
**South Dakota Firemen's Association.**—Twenty-eighth Annual Tournament and Convention.—M. H. Mussman, Secretary, Chamberlain, S. Dak.

**June 18-20.**  
**Georgia Association of Fire Chiefs.**—Annual Convention, Americus, Ga.

**June 19-21.**  
**Wisconsin State Firemen's Association.**—Annual Convention and Tournament, Reedsburg, Wis.—Fred H. Henry, Secretary, Jefferson, Wis.

**June 20-21.**  
**New York State Association of Fire Chiefs.**—Annual Convention, Albany, N. Y.—U. G. Lucas, Secretary, Poughkeepsie, N. Y.

**June 25-27.**  
**South Carolina State Firemen's Association.**—Eighth Annual Convention and Tournament, Rock Hill, S. C.

**June 25-28.**  
**American Institute of Electrical Engineers.**—Annual Convention, Boston, Mass.—F. L. Hutchison, 33 West 39th St., New York.

**June 26-28.**  
**Society for the Promotion of Engineering Education.**—Annual Meeting, Boston, Mass.—H. H. Norris, Secretary, Cornell University, Ithaca, N. Y.

**July 8-12.**  
**National Municipal League.**—Annual Meeting, Los Angeles, Cal.—Clinton Rogers Woodruff, Secretary, 705 North American Building, Philadelphia, Pa.

**September 10-12.**  
**International Association of Fire Engineers.**—Annual Convention, Denver, Col.—James McFall, Secretary, Roanoke, Va.

**September 18-19.**  
**New England Water Works Association.**—Thirty-first Annual Convention, Washington, D. C.—Willard Kent, Secretary.—Headquarters, Boston, Mass.

**September 24-26.**  
**Central States Water Works Association.**—Sixteenth Annual Convention, Detroit, Mich.—R. P. Bricker, Secretary, Shelby, O.

**November 12-15.**  
**American Society of Municipal Improvements.**—Annual Convention, Dallas, Tex.—A. Prescott Folwell, Secretary, 50 Union Square, New York.

### PERSONALS

CARROLL, JAMES E., Crookston, Minn., who has been City Engineer for the past nine years has been appointed Assistant Commissioner of Public Works, St. Paul, Minn.

CHILD, FRANCIS, Newark, N. J., has been re-elected Chairman of the Passaic Valley Sewerage Commission.

ELLIS, J. R., Columbia, Mo., has resigned as City Engineer and will become Assistant City Engineer of Regina, Sask., Canada.

EPPLE, GEORGE, Shreveport, La., has been elected Commissioner of Streets and Parks.

FULLER, GEORGE W., New York City, has been appointed Consulting Engineer to prepare plans and specifications for a sewage disposal plant for Norristown, Pa.

HODGSON, FRANK W., Boston, Mass., has been elected Chief Engineer of the directors of the port of Boston.

KIDDER, J. F., Burlington, Vt., has been appointed Superintendent of Water Works, and E. A. Whitlock has been appointed Superintendent of Streets.

KERCH, C. V., City Engineer, Jonesville, Wis., has been appointed a member of the Board of Public Works.

LEISEIR, THEO. A., Louisville, Ky., has been reappointed Chief Engineer and Superintendent of Water Works.

LINGO, GEORGE, Venice, Cal., has been elected Chief of Police.

MINTON, C. A., Paris, Tex., has been re-appointed Chief of Police, and Edw. Baumgras has been appointed Chief of the Fire Department.

MILLER, I. J.—Lexington, Ky., has been appointed member of the Board of Public Works to succeed S. R. Spurr, resigned.

MURPHY, DR. EUGENE, Augusta, Ga., has been elected President of the Augusta Board of Health for the second consecutive time.

OLSON, DR. G. M., Fargo, N. Dak., has been appointed City Health Officer.

RYAN, JOHN, Dallas, Tex., has been appointed Chief of Police.

STICKLE, KARL O., Alliance, O., has been appointed Chief of the Fire Department.

SHERMAN, ED. C., M. Am. Soc. C. E., has opened offices at 6 Beacon street, Boston, Mass., for the general practise of civil engineering. Mr. Sherman was formerly Designing Engineer with the Isthmian Canal Commission.

STONE, JOSEPH H., Franklin, N. H., has been appointed City Engineer.

STEVENSON, ERWIN B., Albany, N. Y., who has been connected with the Bureau of Water for several years, has been appointed Deputy City Engineer.

TIMMER, JOHN, Grand Rapids, Mich., has been elected president of the Board of Police and Fire Commissioners.

The following mayors have been elected:

FLORIDA.  
De Land—S. A. Wood.  
Cedar Key—W. R. Hodges.

INDIANA  
Jasonville—Stanley Dempsey.

MONTANA.  
Kalispell—D. R. Peeler.

NEBRASKA  
Omaha—James C. Dahlman.

NORTH CAROLINA  
Hickory—J. A. Lentz.

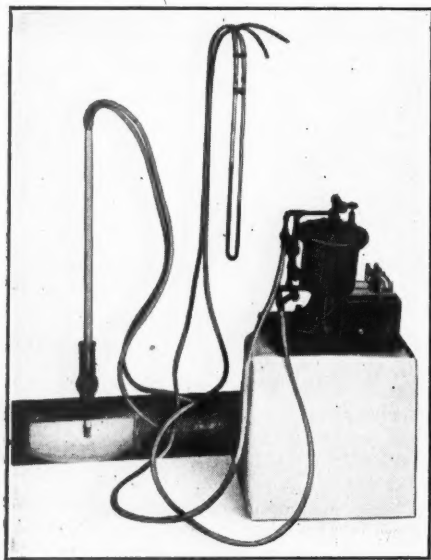
TENNESSEE  
Park City—W. R. Johnson.

VIRGINIA.  
Bristol—Geo. M. Warren.  
Roanoke—Judge John W. Woods.

## MUNICIPAL APPLIANCES

### The Directograph Pitometer

The Directograph Pitometer, made by the Water Works Specialty Co., 140 Dearborn street, Chicago, is an instrument recently invented for the purpose of recording rates of flow in pipes, etc., as measured by pitot tubes, Venturi tubes or other devices in the use of which the result desired is obtained by the measurement of the difference between two pressures. The instrument as described in this article has been designed for use in connection with a pitot tube for measuring the rate of flow in a water main. The pitot tube is of a standard form, having two orifices or pressure openings and connected with pressure tubes passing through a metal casing of such form and length as will permit its insertion into a water main



DIRECTOGRAPH PITOMETER.

through a one-inch opening and allow it to be set at any point across the diameter of the pipe. These two pressure tubes are connected by means of rubber tubes or pipes to a glass "U" tube containing a liquid slightly heavier than water, thus forming a good serviceable indicating flow meter for use in cases where a short test measurement is desired on any pipe line. When it is desired to obtain a continuous record of the rate of flow from which the total output of any line, as, for example, a pumping station discharge, can be computed, the recording device is connected in parallel arrangement with the "U" tube. This method of connection allows the instrument to be used either for indicating or recording the rate of flow and furnishes means for checking the adjustment of the recorder.

The recorder consists of a collapsible metal box of bellows, containing a helical spring made of phosphor bronze wire, enclosed in a cylindrical brass case in such a manner as to form two separate pressure chambers. The upper chamber or inside of the collapsible box is connected to the up-stream or impact orifice of the pitot, and the lower or outer chamber is connected to the down-stream or trailing orifice. If there is no flow in the main line the collapsible box will stand at a normal position of rest, as the pressure in both

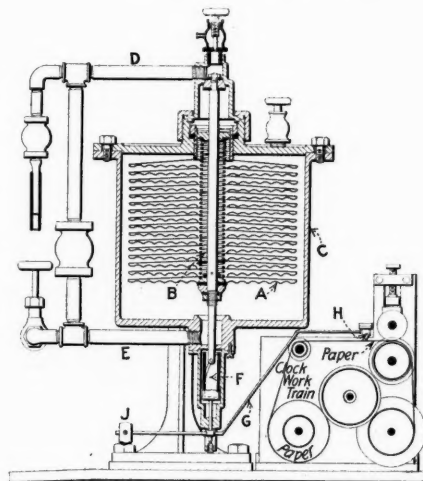
chambers will be equal, but if the water in the main is in motion the pressure in the upper chamber is greater than in the lower chamber and the bellows is extended a distance which is dependent upon the amount of difference between the pressure in the two chambers, and the resistance of the helical spring. This thrust, transformed by means of rollers and cam into a rotary motion, is transmitted through a frictionless packing gland to a pen arm, and thence to a paper chart.

The chart is made in the form of a continuous sheet or ribbon and has parallel lines indicating feet and fractional feet of velocity per second. The mechanism is so constructed that the distance traveled by the pen is directly proportional to the increase in velocity, thus permitting the use of a planimeter for obtaining the average rate of flow for any period of time. This form of chart is especially desirable, since average rates, and therefore total amounts for given periods, can be obtained from it with a minimum amount of office work. In fact, where the flow is fairly steady as at many pumping station outlets the average rate can be obtained by inspection without the use of the planimeter. The portability and convenience of installation, combined with the direct reading chart, make this a particularly desirable meter for the use of the water works engineer, as by its use he can determine the distribution of supply along the lines of the various feeder mains in the system, velocities under which these feeder mains are working, the amount of water used in any particular section of the distribution system, and the actual output of the pumps, and consequently the efficiency of same.

In making field surveys the ease with which it is installed and the small expense involved enable the operator to proceed much more rapidly and to carry on the investigation to include much smaller limits of territory than he would be able to do by the use of meters, which require cutting into the main and the resultant permanent installation of meters or expensive by-pass connections; also the number of meters required to carry on a survey is limited to the number of points at which simultaneous readings are desired, regardless of the size of main, since the same instrument can be used on any size main from a four-inch to the largest size in the system.

Used as a master meter to determine the output from a pump or other source of supply, it offers the same advantage as to convenience and cheapness of in-

stallation. When used on a pump it can be equipped with a special scale attached to the "U" tube, so calibrated as to read in terms of revolutions per minute, thus making a convenient indicating instrument with which to check slip of the pump by a very simple comparison of readings on the scale with readings of the revolution counter. The care of this instrument is much the same as that required by any recording gage, and therefore it can be operated at a station by the engineer or his assistant, who has charge of the various other gages about the plant, without additional expense of expert trained service. This device was designed by W. R. Brown, of Chicago, and tried by him with satisfactory results on both pumping station and field survey tests at Milwaukee, Wis., during the past summer. Patents on this in-



SECTION OF RECORDING APPARATUS.

vention were obtained by the Water Works Specialty Co., of Chicago, and it is now being manufactured by them.

### Aqua-Phone

As its name would indicate, the "Aqua-phone" is an instrument for use in connection with water pipes and water systems of all kinds, especially as an aid for detecting leaks in underground lines.

This is usually accomplished as follows:

A leak is suspected in some certain main or along some line of pipe. A light metal rod (any kind will do), several feet long is driven into the ground at some point as near the pipe as possible. If there is any leak in the vicinity the rod will vibrate. With the "Aqua-phone" held to the ear, exactly as one uses a telephone receiver, and the point held lightly against the metal rod this vibration will become distinctly audi-

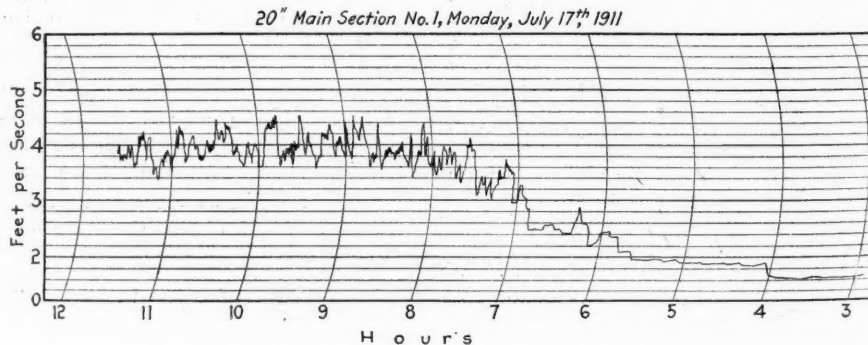


CHART MADE BY DIRECTOGRAPH PITOMETER.



ble and thus the leak is detected. To locate the leak this operation is repeated at nearby points along the line



TELEPHONE FOR DETECTING LEAKS IN WATER MAINS.

of pipe, the point at which the sound is most distinct or loudest, is, of course, the point nearest the leak. By this and similar methods leaks in underground pipes can be located very accurately.

The "Aqua-phone" is also used for testing valves. For instance, the water is shut off from a building at the street or sidewalk. By placing the point of the "Aqua-phone" against the valve (or, if inaccessible, against the long key wrench used for closing the valve) the escape of any water through the valve can readily be detected. Leaks on service pipes or faucets in the house will be indicated by the "Aqua-phone" in contact with the key, valve open.

While primarily used for detecting and locating leaks in underground pipes and valves, the "Aqua-phone" can be successfully put to many other uses.

Place the "Aqua-phone" to the ear with the metal point lightly touching your engine cylinder and ascertain if the piston is cutting. Try it on bearings to discover the presence of gritty substances, or on finely adjusted machines to find if there is any play or lost motion. Hundreds of other uses to which the Aqua-phone can be put will at once suggest themselves to the practical engineer. Briefly, the Aqua-phone, as a scientific acoustic instrument, occupies exactly the same place in the science of sound as the microscope does in the optical world or the stethoscope in the realm of medicine and surgery, and should be handled and used with the same care as these instruments are.

#### Sanitary Drinking Fountain

The A. W. Wheaton Brass Works, Newark, N. J., manufacture a sanitary drinking fountain shown in the illustration, for which the following advantages are claimed:

1. Absolutely sanitary, it being impossible to drink except from "bubbling stream."

2. Mouth cannot come in contact with any metal or substance.

3. The most delicate child can operate the valve with one hand by the slightest pressure at any point on ring.

4. When pressure is removed from ring valve closes automatically and the water is shut off.

5. The bubbling stream is regulated to height desired by a concealed regulating valve. The valve is controlled by a detachable key, which is furnished with each fountain. Impossible for anyone to tamper with valve.

6. Very economical in the use of water.

7. Impossible to make it squirt by placing finger on outlet, as the water will then pass to the waste.

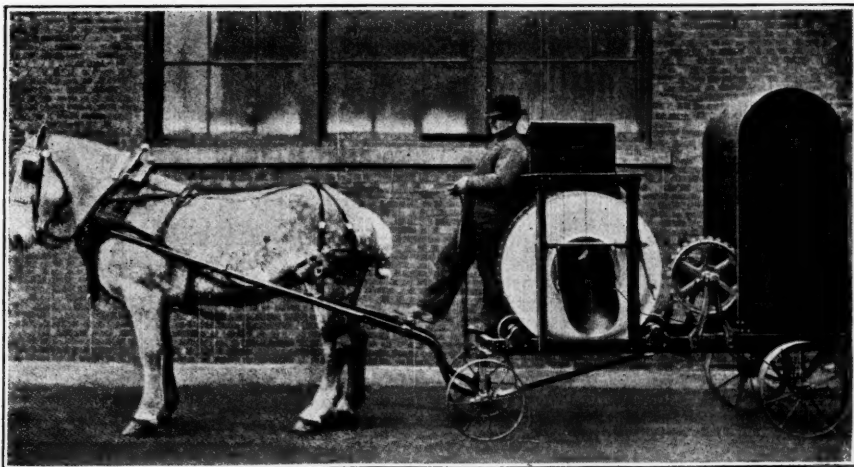
8. It is substantially and simply constructed of cast bronze heavily nickel-plated.

9. Will never have to be repaired or replaced as there are no working parts to get out of order.



SANITARY BUBBLING DRINKING FOUNTAIN.

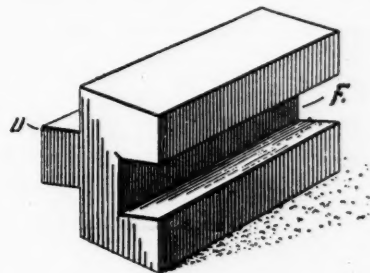
10. This fountain can be installed in connection with any style receptor. The Wheaton company makes several other styles of fountains which are modifications of the one illustrated, which they call their "Special."



CHAIN-BELT SMALL PORTABLE CONCRETE MIXER.

#### Interlocking Paving Brick

C. C. Pettit, of the Greenford Fire Clay Company, Greenford, O., has patented



PAVING BRICK DESIGNED TO ELIMINATE NEED OF CONCRETE FOUNDATION.

ented an interlocking paving brick shown in the illustration, designed to do away with the necessity for a concrete foundation. After the bricks are laid in the street they are jointed with Portland cement grout. These blocks were exhibited at the clay show in Chicago a few months ago and attracted considerable attention. Two years ago in Mahoning county, Ohio, Mr. Pettit laid a section of pavement 150 feet long by 14 feet wide made with these blocks. Three methods of road construction were employed: A curb was laid along the margin in one part, tile drains in another, and in a third the bricks were laid without any special marginal finish. It is stated that there is considerable heavy traffic over the road and that the pavement is in excellent condition. If the manufacturers find it practicable to make a good brick, it seems as if the invention might prove to be a valuable one.

#### Small Chain-Belt Concrete Mixer

A new concrete mixer has been placed on the market by Chain Belt Company, Milwaukee, Wis., to meet the demand for a machine of small capacity that can be easily moved from place to place with one horse. It is particularly well adapted for the use of contractors who have occasion to do small jobs of sidewalk laying and for use in the country for building silos, barn floors, troughs, etc.

The mixer is called the No. 00 and has the capacity of  $4\frac{1}{2}$  cubic feet of loose material or  $3\frac{1}{2}$  cubic feet of mixed materials per batch. It is furnished with gasoline power, being provided with a three-horsepower water-cooled engine. This machine can also be rigged up with an electric motor.

The drum, like those of all Chain Belt Mixers, is made entirely of a special mixture of semi-steel and is cast in two sections.

The mixing is accomplished by means of  $\frac{1}{4}$ -inch steel mixing blades and malleable iron buckets in the interior of the drum. On this machine, as with other Chain Belt Mixers, gears are conspicuous by their absence, as the drum is driven by steel roller chain belt. The roller track surfaces of the drum and the rollers on which it rests are made of chilled semi-steel and there is the least possible opportunity for the moving parts to wear out.

Chain belt mixers are said to run very smoothly and make little noise as compared with gear-driven machines. It is also claimed that they operate with a minimum of power, and that the wear is mostly on the chain, which is easily replaced.

## INDUSTRIAL NEWS

**Cast Iron Pipe.**—Chicago—Contracts for 10,000 tons pipe have been awarded in this district recently. Quotations: 4-inch, \$27; 6 to 12-inch, \$25; 16-inch and up, \$24.50. Cleveland—City awarded contract for which bids were received May 6 for 3,300 tons pipe delivered on street at \$24. Birmingham—Market is strong with decided tendency to advance. Order books are well filled up and inquiries coming in at a good rate. It is said that half the total product of pig iron makers since March 25 has been purchased by pipe makers. Quotations: 4 to 6-inch, \$23; 8 to 12-inch, \$22.50; over 12-inch, \$21.50. New York—It is expected that the city will be in the market before long for pipe for extensions of the high pressure extensions. Private buying is fair. Market is firm. Quotations: 6-inch, car loads, \$22 to \$23.

**Lead.**—The Western lead market has shown a falling off in prices; otherwise that market is without feature. Independents are quoting 4.05c., St. Louis, which is equivalent to the price of the largest interest in New York, which is 4.20c. Demand is light.

**Mexican Asphalt.**—The United States Asphalt Refining Co., 90 West street, New York City, are building a large refinery in Mexico for the purpose of refining asphalt from an asphaltic oil for street paving and other purposes. The material has been prepared on a comparatively small scale and used in a number of American cities. The following tests of asphalt cement made from Aztec asphalt, as the material is called, were made by Dow & Smith, chemical engineers, New York. The purpose was to show the relative susceptibility to changes in temperature and loss on heating of Aztec and other standard asphalts. The description of the samples is as follows. A—Refined Bermudez asphalt, 15 penetration. B—Residium manufactured by Craig Oil Co., 19.2° Beaume gravity. C—Refined California asphalt, 42 penetration. D—Refined Aztec asphalt, 35 penetration. E—Refined California asphalt, 30 penetration. F—Refined Trinidad asphalt, 2 penetration.

susceptibility to changes in temperature.

The material now being manufactured by the company varies from the above in the matter of ductility. Instead of 100 c. m. s. + as above, the material runs from 20 to 85, as required by the specifications adopted by the Organization for Standardizing Paving Specifications.

**Mexican Asphalt.**—The Syracuse Improvement Company, which was formed in 1888, but which for the last twelve years has been inactive, has been reorganized and is going into the oil and asphalt business, working separately, but in harmony with the Warner-Quinlan Asphalt Company. P. R. Quinlan is the principal stockholder of the Syracuse Improvement Company, which is capitalized at \$125,000. The company has just made a contract with the Mexican Petroleum Company of Eban, Mex., for asphaltic oil. The oil will be carried to Warners, on the New Jersey shore of Staten Island Sound, where the Warner-Quinlan Company has twelve acres of land on the water front. At Warners the asphaltic oil will be refined, asphalt and fuel oil being the result. Four tanks, each holding 55,000 barrels and costing between \$25,000 and \$30,000 each, are now being built. Others will be built if the business grows as it is expected to. The contract with the Mexican Oil Company also permits the quantity of oil secured to be increased annually, according to the demand for it. The company has secured from the Mexican company the exclusive right to market its asphaltic oil in the United States, although it has not the exclusive rights for the fuel oil. The Standard Oil Company recently contracted for 6,000,000 barrels of the fuel oil from the Mexican company. About eighty men are now at work building the plant of the Syracuse Improvement Company adjoining that of the Warner-Quinlan Company on Staten Island Sound, and C. E. Extrand, an experienced Pennsylvania oil man and a mechanical engineer, has been made superintendent. C. A. Miller, of New Lima, O., is his assistant. Mr. Quinlan said that the

with their values per long ton, were as follows: From Germany, 24,960 tons (\$11.33); France, 11,985 tons (\$10.27); Italy, 10,308 tons (\$9); British West Africa, 15,421 tons (\$14); United States, 3,697 tons (\$20). In London asphalt paving is practically in the hands of two firms, one French and one Italian, which are constantly employed in relaying and repairing streets and footways. Outside the city area the maintenance of roads and walks is controlled by the various municipal boroughs, and the work is done by contractors who are the successful bidders. Except in the city itself, wood blocks and macadam are more generally used than asphalt, but there is, notwithstanding, a considerable part laid with the latter.

**Neuchatel Asphalt.**—Consul Francis B. Keene, of Geneva, learns that the only exploitation of asphalt in Switzerland is at Travers, Canton of Neuchatel, by the Neuchatel Asphalt Co., of London, England. It would appear from statistics that the annual extraction amounts to about 25,000 metric tons and that there is enough asphalt to keep the company running for a hundred years.

**Safety Trench Brace.**—Harold L. Bond Company, Boston, Mass., are urging on contractors the use of their Extensible Safety Trench Brace, in view of the greater responsibility placed on contractors by recent legislation in a number of States in employers' liability acts. Either end of this trench brace has an iron lug that rests on the ranger, thus preventing the brace from dropping into the trench, thus preventing one cause of cave-ins.

**Medal Paving Block.**—It seems probable that Medal block brick, manufactured by the Deckman-Duty Brick Company, will be used to a considerable extent in paving the streets of Muncie, Ind., this summer. Councilmen Hummel and Meeker, together with City Engineer Deardorf, have returned from Cleveland, where they inspected several miles of roadways improved with the Medal block and they were favorably impressed with the paving material.

**Trenching Machine.**—Stewart, Streets & Co., contractors for sewers in Vincennes, Ind., are using a Buckeye trenching machine on their work. The trenches are dug by hand to a sufficient depth to expose all gas and water pipes. These are cut and plugged and the Buckeye machines does the rest.

**Flushing Machine.**—A Studebaker flushing machine is being operated experimentally in Bozeman, Mont., and Mayor Woods is very much pleased with the results. When it was first tried the dirt and mud was two inches deep on the main streets, notwithstanding this it washed the mass from the surface with comparative ease, carrying it to the gutters, from which it was removed in carts. There are 20 paved blocks in Bozeman and the flusher goes over them all in about twelve hours.

**Turbo-Blower.**—The Coppus Engineering & Equipment Company, Union and Schools streets, Worcester, Mass., has been incorporated in Massachusetts and will manufacture and place on the market a new turbo-blower, the invention of Frans H. C. Coppus, of that city. Mr. Coppus is the president and treasurer; Fritz W. Schmidt, vice-president, and Linwood M. Erskine the third director. The company has a capital stock of \$50,000.

	Aztec, 100 parts.	Trinidad, 100 parts.	Bermudez, 100 parts.	California— No. 6714. No. 6108.	
Aztec Refined Asphalt—A.....	100 parts.				
Trinidad Refined Asphalt—B.....		100 parts.			
Bermudez Refined Asphalt—C.....			100 parts.		
California Refined Asphalt—D.....				100 parts.	
California Refined Asphalt—E.....					100 parts.
Craig Residium F.....	7.6 parts.	23.0 parts.	17.5 parts.	9 parts.	9
Penetration at 32° F.....	17	14.5	12	10	9
Penetration at 77° F.....	54	54.0	51	51	53
Penetration at 115° F.....	269	291.0	280	370	403
Ratio.....	1:3.2:15.8	1:3.7:20.0	1:4.3:23.3	1:5.1:37.0	1:5.9:44.8
Ductility at 77° F.....	100 cms. +	37 cms.	45 cms.	100 cms. +	100 cms. +
Per cent. loss on heating 5 hrs., at 325° F....	Trace.	0.40%	2.15%	0.45%	0.25%
Penetration at 77° F. after ditto.....	40	41.0	29	27	31
Loss in penetration after ditto (hardening)....	14	13.0	22	24	22
Per cent. loss in penetration after do. (hardening).....	26.0%	24.1%	43.1%	47.0%	41.5%

The chemists comment on the tests as follows: The above tests show that your Aztec asphalt is as high in cementing value and ductility as any known asphalt and is at the same time less susceptible to changes in temperature. In all other cases that we know of the more cementitious and ductile the asphalt the more has it been affected by changes in temperature, and it has long been recognized that, other things being equal, the ideal asphalt would be one that combined high ductility and cementitiousness with slight

Syracuse Improvement Company intended to deal in oil and asphalt, leaving all construction and paving contracts for the Warner-Quinlan Company. The new corporation expects to be an active rival of the so-called Asphalt Trust. The certificate showing the extension of the powers and purposes of the improvement company was filed May 1 with the county clerk.

**Rock Asphalt.**—The United Kingdom imports about 65,000 tons of rock asphalt annually. In 1910 the quantities bought from various countries,



**Johns-Manville Organization.**—The executive offices and New York show-rooms of the H. W. Johns-Manville Company, manufacturers of asbestos, magnesia and electrical supplies, were moved on April 20 to the new 12-story "H. W. Johns-Manville Building," Madison avenue and 41st street, New York City, from their old quarters at 100 William street, where they have been located for the last 15 years.

This move marks the 54th anniversary of the company. Under the name of H. W. Johns Manufacturing Company, the business was conducted at 87 Maiden lane previous to May 1, 1897, when it was moved to 100 William street. In 1901 the firm name was changed to H. W. Johns-Manville Company, a consolidation being affected between the Manville Covering Co., of Milwaukee, Wis., and H. W. Johns Manufacturing Co. This last combination brought together two of the largest manufacturers of pipe and boiler coverings, packings, roofings, etc., in the world, and the growth of the company since that time has been almost phenomenal.

They now have factories located in Brooklyn, N. Y., Milwaukee, Wis., West Milwaukee, Wis., Hartford, Conn., Nashua, N. H., Lockport, N. Y., and Newark, N. J., with an asphalt refinery at South Amboy, N. J., and extensive asbestos mines at Danville, in the Province of Quebec, Canada, which are the largest in existence and produce an exceptionally fine grade of asbestos. They also have a branch house in every city of any size in the United States and Canada, as well as representatives in about all foreign countries.

In the new quarters the company will have the distinction of being one of the few manufacturing concerns which occupy an entire 12-story office building. In its entirety the company now occupies over 2,657,160 square feet of floor space, or about 61 acres. The employees number approximately 5,000 and there are about 425 salesmen.

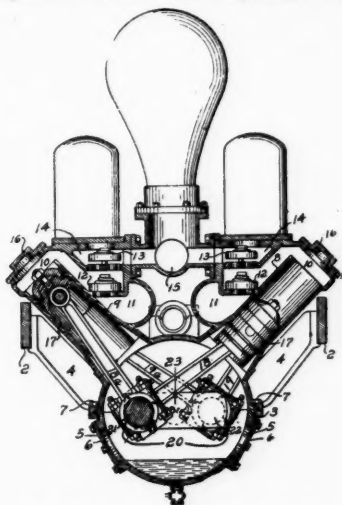
Increased business interests in this and other parts of the country have necessitated the move. The large floor area and spacious rooms in the new building will enable a much larger and more complete stock of goods being carried on hand than heretofore, and will also permit of a better supervision over the company's long chain of branch offices, warehouses, stores and factories scattered throughout the United States and Canada.

**New Tar Heater and Spreader.**—The American Road Construction Company, Haverhill, Mass., has been organized with a capital of \$10,000, to manufacture a new machine for heating and spraying bituminous products. Leslie K. Morse is president; George E. Hutchins, formerly city engineer, is secretary and treasurer, and Louis E. Miner, vice-president and superintendent of construction of the new company. The machine was invented by Mr. Miner. It is said to be the only machine of its kind patented in the United States which uses a steam process. The machine will be placed on the market on a royalty basis at so much per square yard. The members of the company are very sanguine regarding their machine and state they have already received orders for fourteen machines. It is claimed that the machine will revolutionize the manner of spreading Tarvia and will do in five hours what will take men working by hand five days to accomplish.

## PATENT CLAIMS

**1,024,919. PUMP.** Frederick L. Waterous, St. Paul, Minn. Serial No. 598,645.

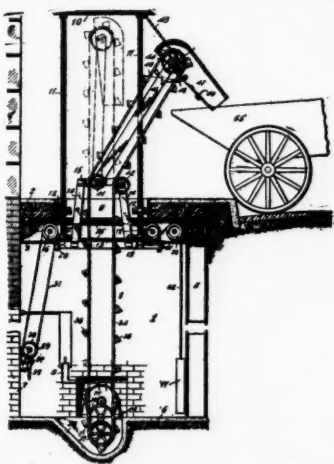
A pump comprising a crank case, cylinders mounted in pairs side by side and radiating from said crank case on diverging lines on opposite sides of the longitudinal center of said crank case, pistons for said cylinders, a shaft having double crank rods connecting said pistons with said cranks, said rods being so disposed with respect to said cranks that when a piston of one cylinder is drawn inwardly the piston of the other cylinder on the



same side of the crank case will be forced outwardly, said cylinders having openings in their outer ends the full diameter of the cylinders, housings disposed on each side of the longitudinal center line of said crank case and having inlet chambers located near the inner ends of said cylinders and extending along beside the inner walls thereof and communicating with the open ends of said cylinders, inlet valves disposed opposite the middle portion of said cylinders and separating the lower portions of said inlet chambers from the open ends of said cylinders, said housings also having outlet chambers disposed above said inlet chambers and also on opposite sides of the longitudinal center line of said crank case and provided with ports communicating with said inlet chambers, and valves for said ports, said valves being disposed above said inlet valves, and a centrally arranged outlet pipe communicating with said outlet chambers.

**1,025,168. SIDEWALK ENDLESS ASH-CONVEYER.** August Sundh, Yonkers, N. Y., assignor to Otis Elevator Co., Jersey City, N. J., a Corporation of New Jersey. Serial No. 388,814.

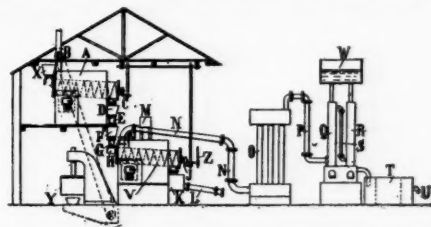
The combination with a walk provided with an opening therethrough, of a cover for the opening, a vertically movable frame carrying said cover, a compart-



ment beneath the opening, an endless conveyor having its lower portion in the compartment and its upper portion supported within said frame and movable therewith, and means for driving the conveyor.

**1,025,622. TREATMENT OF SEWAGE-SLUDGE.** Jacob Grossmann, Manchester, England. Serial No. 507,699.

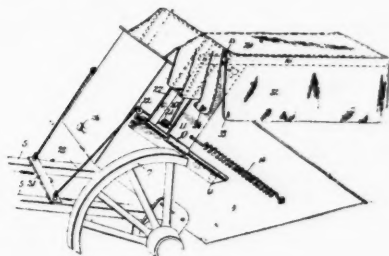
The herein described method of treating sewage sludge, which consists in



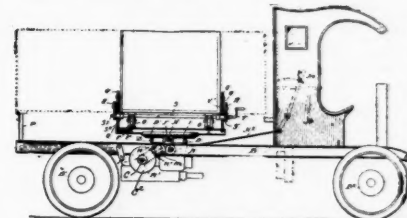
desiccating the same mechanically, then drying the product to a suitable consistency, then mixing the dried sludge with a suitable quantity of sulfuric acid, then subjecting the resulting mixture to the simultaneous action of superheated steam and to agitation, then condensing the steam and volatilized products of distillation and finally separating the fatty acid and grease from the products of condensation.

**1,024,959. DUMPING-CART.** Lesser Wolf, New York, N. Y., assignor of one-half to Herbert Blankfort, Brooklyn, N. Y. Serial No. 624,536.

In a dumping-cart a member, a body pivoted relatively thereto, a guideway on the body, a support having a guide for traveling on the guideway, a hood mounted on the support, and connecting means between the support and the member for holding the support and preventing its movement with the body when the body is rotated.



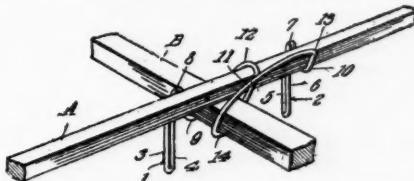
**1,024,636. SIDE-DUMP AUTOTRUCK.** George Washington Gally, Boston, Mass. Serial No. 554,595.



In a device of the kind described, a frame comprising parallel beams, a second frame at right angles to and above the first mentioned frame, a bearing ring mounted upon the first mentioned frame, a second ring mounted upon the first, the second mentioned ring supporting the second mentioned frame, a bearing member centrally arranged in the first mentioned frame and supported therefrom, and a second bearing member centrally arranged in the second mentioned frame, turning upon the bearing member of the first mentioned frame, and means imparting rotation to the second mentioned ring.

**1,025,330. WIRE CLIP FOR CONCRETE CONSTRUCTION.** Joseph H. Straus, Jr., Baltimore, Md., assignor of one-half to Raymond H. Williams, Baltimore, Md. Serial No. 679,909.

A wire clip for securing together crossing bars for concrete reinforcement comprising an upright leg or support at one end, an adjacent downward curve for en-



gaging under one of the bars, bends in the wire extending in position to pass over the second bar and under the first bar, and a support at the other end of the wire.

## THE WEEK'S CONTRACT NEWS

Relating to Municipal and Public Work—Street Improvements—Paving, Road Making, Cleaning and Sprinkling—Sewerage, Water Supply and Public Lighting—Fire Equipment and Supplies—Bridges and Concrete Work—Sanitation Garbage and Waste Disposal—Police, Parks and Miscellaneous—Proposals and Awards.

To be of value this matter must be printed in the number immediately following its receipt, which makes it impossible for us to verify it all. Our sources of information are believed to be reliable, but we cannot guarantee the correctness of all items. Parties in charge of proposed work are requested to send us information concerning it as early as possible; also corrections of any errors discovered.

## BIDS ASKED FOR

STATE	CITY	RECEIVED UNTIL	NATURE OF WORK.	ADDRESS INQUIRIES TO
<b>STREET IMPROVEMENTS</b>				
Indiana	Indianapolis	May 20, 10 a.m.	Constr. culvert.	Chas. Maguire, Chm. County Comm.
Kentucky	Louisville	May 20	Pavg. alleys with brick; cost, \$27,500.	Board Public Works.
Iowa	Winterset	May 20	Constr. 2 miles brick asphalt, bitulithic or concrete.	H. S. Ely, City Clk.
New York	Plattsburg	May 20, 7.30 p.m.	Constr. 2,190 sq. yds. crossotated wood block pav't.	H. J. Langlois, City Engr.
Minnesota	Breckinridge	May 20, 10 a.m.	Constr. 1½ miles of road.	P. E. Truax, County Aud.
Washington	Montesano	May 20	Imp. State road No. 9.	R. G. Trask, County Aud.
New York	Newburg	May 20, 5 p.m.	Resurf. with bitulithic.	W. J. Blake, Jr., City Engr.
Wisconsin	Superior	May 20, 10 a.m.	Pavg. Tower avenue.	City Clerk.
North Carolina	Rocky Mount	May 20, noon	Constr. 20,000 sq. yds. granolithic sidewalk pav'ts and 20,000 ft. concrete curbing.	J. B. Ramsey, Mayor.
Minnesota	Minneapolis	May 20, 11 a.m.	Constr. concrete road.	A. P. Erickson, County Aud.
Illinois	Woodstock	May 20, 1 p.m.	Constr. 14,837 sq. yds. vit. brick pav't and 2,660 lin. ft. conc. curb, 1,321 ft. storm water sewer connects. & appur.	Pres. Board Local Improvements.
New York	Randolph	May 20, 8 p.m.	Pavg. portions of a number of streets.	F. A. Babbitt, Vil. Clk.
Oklahoma	Muskogee	May 20, 10 a.m.	Pavg. and draining streets.	Chas. Wheeler, Jr., City Clk.
Ohio	Coshocton	May 20, 1 p.m.	Constr. 2.37 miles bituminous macadam.	County Comm.
North Dakota	Bismarck	May 20, 8 p.m.	Constr. 5,000 sq. ft. cement walk.	R. Penwarden, Clk. Bd. Education.
North Dakota	Bismarck	May 20, 8 p.m.	Gradv. several streets.	R. H. Thistlethwaite, City Aud.
Oklahoma	Muskogee	May 21, 10 a.m.	Constr. pav'ts.	Charles Wheeler, Jr., City Clk.
Utah	Logan	May 21, 8 p.m.	Constr. 285,000 sq. ft. concrete walk, etc.	City Commissioners.
Missouri	Eldorado Springs	May 21	Constr. 1,500 yds. concrete pav't.	O. E. Siders, Clk.
Kentucky	Louisville	May 22, 2 p.m.	Imp. sidewalks.	J. D. Wakefield, Chm. Bd. Pub. Wks.
Ohio	Toledo	May 22, noon	Constr. brick pav't.	F. G. Stockton, Sec'y Dir. Pb. Serv.
Texas	Paris	May 21	Constr. road.	W. S. Gill, Sec'y Road Comrs.
Washington	Seattle	May 21, 2 p.m.	Constr. highways.	Board County Commissioners.
Minnesota	Glenwood	May 21, 10 a.m.	Gradv. road.	Ole Irgens, County Aud.
Indiana	Richmond	May 21, 10 a.m.	Constr. cement roadway.	Board Public Works.
Indiana	Fowler	May 21, 11 a.m.	Constr. gravel roads.	L. Shipman, County Aud.
Pennsylvania	Harrisburg	May 21	Constr. 7 miles asphaltic concrete road.	E. M. Biglow, Comm. Highways.
Michigan	Hillsdale	May 21, noon	Constr. 9,500 sq. yds. asphalt block bit. conc. or conc. base.	C. L. Heron, City Engr.
Alabama	Scottsboro	May 21, 11 a.m.	Macad. 2.7 miles road and grading 6.7 miles.	W. S. Keller, Highway Engr.
Alabama	Carrollton	May 22	Constr. 4 miles of sand clay road.	W. S. Keller, State Highway Engr.
Ohio	Cleveland	May 22, 11 a.m.	Imp. canal road No. 2.	J. F. Goldenbogen, Clk.
Ohio	Chardon	May 22, noon	Constr. 3,960 ft. bituminated concrete; est. cost, \$11,843.28.	Jas. R. Marker, State H'way Comm.
Indiana	Logansport	May 22, 10 a.m.	Constr. pav'ts, etc.	D. D. Fickle, Chm. Pub. Wks.
Illinois	Jerseyville	May 23, 4.30 p.m.	Constr. 17,000 yds. brick pav't and 11,500 ft. comb. curb and gutter.	E. B. Shafer, Con. Engr.
Indiana	Logansport	May 23, 10 a.m.	Constr. pav'ts, etc.	D. D. Fickle, Chm. Pub. Wks.
Ohio	Jefferson	May 23, noon	Pavg. 1.61 miles bituminated concrete; est. cost, \$12,475.67.	Jas. R. Marker, State H'way Comm.
Indiana	Fort Wayne	May 23, 7.30 p.m.	Constr. pav'ts, sidewalks, cross-walks, etc.	Board Public Works.
New York	Poughkeepsie	May 23, 4 p.m.	Constr. sheet asphalt pav't.	R. J. Harding, Supt. Bd. Pub. Wks.
Alabama	Roanoke	May 24	Constr. 9 miles sand clay road.	W. S. Keller, Highway Engr.
New York	Westfield	May 24, 8 p.m.	Pavg. with brick.	J. A. Riley, Vil. Clk.
Ohio	Warren	May 24, noon	Constr. 2.69 miles highway with bituminated concrete; est. cost, \$18,471.98.	J. R. Marker, State Highway Comr.
Iowa	Vinton	May 24	Constr. 7,000 ft. curb, 15,000 yds. brick or concrete paving.	W. E. Clingman, City Clk.
Indiana	Terre Haute	May 25, 11 a.m.	Constr. 2½ miles gravel road.	N. G. Wallace, County Aud.
Ohio	Lancaster	May 25, 10 a.m.	Macad. 4½ miles road.	County Commissioners.
Ohio	Marysville	May 25, noon	Imp. road.	C. A. Morelock, County Aud.
Minnesota	Hastings	May 27, 10 a.m.	Gradv. road.	T. A. Hoffman, County Aud.
Pennsylvania	Wanamie	May 27, 7.30 p.m.	Gradv. paving and curbing number of streets.	W. O. Davis, Sec'y Bd. Comrs.
Canada	Sault Ste. Marie	May 27	Constr. 169,000 sq. ft. cement sidewalk & 21,000 ft. curb.	W. W. Van Every, City Engr.
Ohio	Cleveland	May 27, noon	Pavg. at fire engine house.	C. W. Stage, Dir. Pub. Serv.
New Jersey	Freehold	May 27, 11 a.m.	Constr. gravel road.	J. M. Corlies, Dir. Freeholders.
Wisconsin	LaCrosse	May 27, 3 p.m.	Constr. 5,000 yds. granite top macadam, etc.	J. T. Day, Chm. Bd. Pub. Wks.
Dist. Columbia	Washington	May 28, 2 p.m.	Furn. granite curbing.	District Commissioner.
Michigan	Milan	May 28, noon	Constr. street paving.	Jesse Button, Vil. Clk.; George Champe, Engineer, Toledo.
Pennsylvania	Lancaster	May 28	Pavg. a number of streets.	City Comptroller.
Pennsylvania	Harrisburg	May 28, 10 a.m.	Constr. 24,603.5 ft. asphaltic concrete road 16 ft. wide.	E. H. Bigelow, State Highway Comr.
Iowa	Clarinda	May 28, 7.30 p.m.	Imp. various sts., 12,300 sq. yds. pavg., 7,450 lin. ft. curbing.	C. W. Stuart, City Clk.
Rhode Island	Providence	May 29	Constr. 30 miles macadam highway.	State Board Public Roads.
Wisconsin	Madison	May 29, 2 p.m.	Gradv. paving and curbing number of streets.	J. F. Icke, City Engr.
Ohio	Bellaire	May 29, noon	Constr. brick roadway.	Wm. J. Campbell, Township Clk.
Iowa	Iowa Falls	May 29, 2 p.m.	Pavg. several streets.	J. V. Gregg, City Clk.
Ohio	Cincinnati	May 31, noon	Oiling several roads.	Stanley Struble, Pres. Bd. Co. Com.
Ohio	Canton	June 1	Pavg. Broadway with brick block.	R. F. Harbent, Dir. Pub. Serv.
Missouri	Fulton	June 1	Excav. 120,000 cu. yds. earth.	W. R. Heager, County Engr.
Ohio	Cleveland	June 1, 11 a.m.	Imp. road.	F. R. Lander, County Surv.
Kansas	Winchester	June 3, noon	Constr. sidewalks.	J. B. Armstead, Mayor.
Indiana	Huntington	June 3, 10 a.m.	Constr. gravel road.	H. Guthrie, County Aud.
Indiana	Jasper	June 3, 1 p.m.	Constr. gravel road.	J. H. Seng, County Aud.
Indiana	Marion	June 4, 2 p.m.	Constr. several highways.	E. H. Kimball, County Aud.
Ohio	York	June 4, noon	Constr. 2.4 miles macadam.	G. L. Bonar, Clk.
Indiana	Vincennes	June 4, 2 p.m.	Constr. 2 miles gravel roads.	J. T. Scott, County Aud.
Indiana	Crawfordsville	June 4, 10 a.m.	Pavg. several roads.	B. B. Engle, County Aud.
Ohio	Columbus	June 4	Macad. 1 road, imp. 2.	County Commissioners.
Louisiana	Lake Charles	June 4, 8 p.m.	Constr. 5 miles of pav't.	C. B. Richard, Mayor.
Illinois	Ashton	June 4, 1 p.m.	Macadam, 6 miles of road and redressing 5½ miles of road.	Geo. B. Stephan, Town Clk.
Ohio	Norwalk	June 5, 1 p.m.	Constr. 1 mile concrete roadway and 1¼ macad. road.	A. E. Ward, Clk.
North Dakota	Bowdon	June 10, 2 p.m.	Gradv. approaches to bridge.	O. H. Gramppmann, Chm.
Ohio	Cleveland Hgts.	June 18, noon	Treating roads with oil.	H. H. Canfield, Vil. Clk.
Ohio	Newark	June 20 (about)	Constr. 8,590 sq. yds. pav't and 4,810 lin. ft. curbing.	C. H. Wells, City Engr.
Oregon	Fossil	July 3, 1 p.m.	Constr. roads and bridges.	H. F. C. Heidtmann, County Surv.



## BIDS ASKED FOR

STATE	CITY	RECEIVED UNTIL	NATURE OF WORK	ADDRESS INQUIRIES TO
<b>SEWERAGE</b>				
Illinois.....	Rochelle.....	May 20.....	Constrn. 2 miles 6 to 18-in. sewers.....	Aetna Eng. Bureau, Chicago.
Michigan.....	Otsego.....	May 20, noon.....	Constrn. number of sewers.....	W. G. Conlan, Vil. Clk.
Florida.....	Lakeland.....	May 20, 3 p.m.....	Constrn. sewers and disposal plant.....	C. G. Memminger, Chm. Trustees.
Michigan.....	Bay City.....	May 20, 9 a.m.....	Constrn. 12 and 30-in. socket tile sewers.....	R. O. Woodruff, Chm. Bd. Pb. Wks.
Minnesota.....	Fergus Falls.....	May 20.....	Constrn. sewers on Vernon avenue.....	S. A. Levenson, City Clk.
Indiana.....	Michigan City.....	May 21, 10 a.m.....	Constrn. sewer.....	Board Public Works.
Iowa.....	Ashton.....	May 21, 7.30 p.m.....	Constrn. 4,300 ft. 6 to 10-in. sewers.....	J. W. Clark, Town Clk.
Illinois.....	Sandwich.....	May 21, 2 p.m.....	Constrn. sanitary sewers.....	F. S. Mosher, Pres. Bd. Local Imp.
Virginia.....	Norfolk.....	May 22.....	Constrn. of sewers in several streets.....	W. T. Brooks, City Engineer.
New Jersey.....	Trenton.....	May 22, 8 p.m.....	Constrn. sewers on 3 streets.....	H. B. Salter, City Clk.
Maryland.....	Baltimore.....	May 22, 11 a.m.....	Constrn. 16,000 ft. 8 to 24-in. clay pipe sewer and 3,100 ft. house connection.....	Board of Awards.
Missouri.....	Maplewood.....	May 22, 8 p.m.....	Constrn. new sewer system, district No. 1.....	M. F. O'Brien, City Clk.; R. E. McMath Surv. Co., Con. Engrs., St. Louis, Mo.
Rhode Island.....	Woonsocket.....	May 23, 2 p.m.....	Constrn. 8,200 ft. 8-in., 10-in. and 12-in. sewers.....	F. H. Mills, City Engr.
Indiana.....	Fort Wayne.....	May 23, 7.30 p.m.....	Constrn. local sewer.....	Board Public Works.
Dist. Columbia.....	Washington.....	May 24.....	Constrn. water & sewer connections at Indian School, Colorado River, Ariz.....	Indian Office.
Illinois.....	Lawrenceville.....	May 26.....	Constrn. sewer system; cost, \$45,000.....	R. I. Bouetiel, City Engr.
Wisconsin.....	Ashland.....	May 27, 10 a.m.....	Constrn. sewers.....	W. C. Morris, City Clk.
Canada.....	Sault Ste. Marie.....	May 27.....	Constrn. 21,000 ft. tile sewer and appurt.....	W. W. Van Every, City Engr.
Michigan.....	Ironwood.....	May 28.....	Constrn. 7,000 ft. 18-in. tile sewer.....	W. D. Snyder, City Clk.
Pennsylvania.....	Lancaster.....	May 28.....	Constrn. sewers in various streets.....	City Comptroller.
Georgia.....	Macon.....	May 28.....	Constrn. 6 miles 8 to 12-in. sanitary sewers.....	Bridges Smith, Clk.
New Jersey.....	Newark.....	May 28.....	Constrn. Section 9, Passaic Valley sewer.....	Commissioners.
Minnesota.....	Shakopee.....	May 28, 8 p.m.....	Constrn. sanitary sewer extension.....	City Council; Oscar Claussen, Engr., St. Paul, Minn.
Pennsylvania.....	Ardmore.....	May 28, noon.....	Install. pump. mchy. to lift 1,500,000-gal. of sewage per day.....	Township Comrs.; R. A. Warner, C. E., Engr., Box 708.
Ohio.....	Canton.....	June 15.....	Extend. storm sewer, Liberty street.....	P. H. Weber, City Engr.
<b>WATER SUPPLY</b>				
Florida.....	Jacksonville.....	May 20.....	Furn. 2,000 water meters.....	Trustees, Water Works.
Florida.....	Titusville.....	May 20.....	Constrn. water works.....	Geo. M. Robbins, Chm. Bond & Trus.
Utah.....	Salt Lake City.....	May 20.....	Lay. water mains.....	Board County Commissioners.
Minnesota.....	Benson.....	May 20, 8 p.m.....	Lay. 1,560 ft. 4-in. water main.....	O. J. Olsen, City Clk.
North Carolina.....	Reidsville.....	May 21, 8 p.m.....	Constrn. 5½ miles wood pipe, filter plant and pump. station.....	Francis Womack, Mayor.
Michigan.....	Grand Haven.....	May 21.....	Constrn. of 3,200 feet of 16-inch suction main.....	City Clerk.
Texas.....	New Braunfels.....	May 22, 10 a.m.....	Constrn. water and lighting plant.....	C. A. Jahn, Mayor.
Missouri.....	Fulton.....	May 22.....	Install. air compressor, tank, centrifugal fire pumps, electrical equipment, etc.....	Dr. G. Williams, Supt. State Hosp.
Maryland.....	Baltimore.....	May 22, 11 a.m.....	Furn. and install. pipe line.....	Board of Awards.
Indiana.....	South Bend.....	May 22, 10 a.m.....	Constrn. water connections.....	O. C. Bastian, Chm. Dept. Pub. Wks.
Illinois.....	Ashton.....	May 23, 1 p.m.....	Constrn. 6 miles 4 to 8-in. mains, tanks, well & pump. mchy.....	S. T. Zeller, Jr., Vil. Pres.; Aetna Engineering Bureau, Chicago.
Kentucky.....	Lexington.....	May 24.....	Constrn. settling basin.....	Lexington Hydraulic & Mfg. Co.
Rhode Island.....	Newport.....	May 25, 11 a.m.....	Renewing water-piping.....	Navy Department.
New York.....	East Williston.....	May 27.....	Furn. 12,225 ft. 4 to 8-in. pipe, hydrants, valves, etc.....	F. L. Oakley, Chm. Water Comm.
Minnesota.....	Shakopee.....	May 28, 8 p.m.....	Constrn. water main.....	City Council.
Canada.....	Medford, Sask.....	May 29, noon.....	Constrn. reservoir and distribution system.....	J. E. Durnin, Sec'y-Treas.
Montana.....	Shelby.....	May 29.....	Constrn. 40,000 ft. 6 and 8-in. wood pipe, 3,000 ft. 8-in. steel pipe, etc.....	J. E. Nolan, City Engr.
Virginia.....	Norfolk.....	May 29, 12.30 p.m.....	Constrn. water pipes, valves, hydrants, etc.....	W. T. Brooke, City Engr.
Canada.....	Hamilton, Ont.....	May 30.....	Furn. special castings for pumping station, Ventura meters, cranes, etc.....	G. H. Lees, Mayor.
Illinois.....	Peoria Heights.....	June 1.....	Constrn. municipal well water system; cost, \$60,000.....	Village Clerk.
Colorado.....	Aguilar.....	June 1 (about).....	Constrn. water works; cost, \$70,000.....	City Clerk.
Florida.....	Lakeland.....	June 1.....	Constrn. water gas plant, 150,000 cu. ft. capacity.....	Lakeland Gas Co.
Montana.....	Shelby.....	June 10.....	Constrn. of water works, cost \$20,000.....	J. E. Nolan, City Engineer.
West Virginia.....	Elkins.....	June 15, 4 p.m.....	Repair. reservoir.....	George Henry, City Clk.
<b>LIGHTING AND POWER</b>				
Illinois.....	Elgin.....	May 20.....	Install. motors, triplex pumps, centrif. pumps & elec. supplies.....	Board of Administration.
Texas.....	New Braunfels.....	May 22, 10 a.m.....	Constrn. power plant, lighting system and transmission line.....	C. A. Jahn, Mayor.
Nebraska.....	Kearney.....	May 22.....	Constrn. elec. light plant.....	C. E. Ford, City Clerk.
Iowa.....	Vinton.....	May 24.....	Constrn. power house; cost, \$11,000.....	W. E. Chingman, City Clk.
North Dakota.....	Jamestown.....	May 27.....	Install. street lighting system in business district.....	City Clk.
Canada.....	Medford, Sask.....	May 29, noon.....	Furn. material for electric lighting plant complete.....	J. E. Durnin, Sec'y-Treas.
Louisiana.....	New Orleans.....	June 20, noon.....	Constrn. power house.....	F. S. Shields, Sec'y.
<b>FIRE EQUIPMENT</b>				
Ohio.....	Canton.....	May 20 (about).....	Furn. equipment for fire department.....	Thos. Dunwoodie, Dir. Pub. Safety.
Illinois.....	Antioch.....	May 20, 8 p.m.....	Constrn. village hall and fire house.....	Trustees.
New York.....	Auburn.....	May 20, 4 p.m.....	Furn. combination auto hose wagon and 1 tractor.....	J. F. Hanlon, City Clk.
Ohio.....	Cleveland.....	May 22, noon.....	Constrn. fire house.....	C. W. Stage, Dir. Public Safety.
South Carolina.....	Florence.....	May 22.....	Furn. 10 fire alarm boxes.....	W. H. Perry, Chm.
New York.....	Niagara Falls.....	May 23, 7.30 p.m.....	Erect. 2 fire halls; est. cost, \$15,000 and \$8,000.....	Board Fire Commissioners.
Canada.....	Regina, Sask.....	May 25.....	Furn. one 75-ft. motor aerial ladder truck, 1 motor comb. hose & chem. wagon, 1 horse-drawn comb. hose & chem. wagon and 1 horse-drawn hook and ladder truck.....	City Comrs.; W. A. White, Chief Fire Dept.
Michigan.....	Detroit.....	May 27, 3 p.m.....	Furn. 3 auto engines, motor ladder truck, converting ladder truck, motor comb. hose & chem. wagon, auto squadron car and 5 chief's cars.....	G. W. Stockwell, Sec'y Fire Comm.
Michigan.....	St. Joseph.....	June 1.....	Furn. 500 ft. fire hose.....	H. G. Hughson, Chief Dept.
Kansas.....	Wichita.....	June 3.....	Constrn. fire and police telegraph system.....	Wm. Sence, City Clk.
Ohio.....	Cleveland.....	June 7, noon.....	Furn. pumps for fire service pumping station.....	W. J. Springborn, Dir. Public Serv.
Louisiana.....	New Orleans.....	June 20, noon.....	Constrn. power house and canals.....	F. S. Shields, Sec'y Water Bd.
<b>BRIDGES</b>				
Pennsylvania.....	Hollidaysburg.....	May 21, noon.....	Constrn. 4 reinforced concrete bridges.....	W. J. Hostler, Clk. Comrs.
Pennsylvania.....	Altoona.....	May 21, noon.....	Constrn. 4 concrete bridges.....	County Comm.
Tennessee.....	Chatanooga.....	May 27.....	Constrn. McCallie avenue viaduct.....	Bridge Commissioners.
Nebraska.....	Gering.....	May 29.....	Constrn. of bridge, 800 feet long.....	J. H. Ferguson, County Clerk.
Ohio.....	Columbus.....	May 31.....	Constrn. reinforced concrete arch bridge.....	F. M. Sayre, County Aud.
Kansas.....	Topeka.....	May 31.....	Reconstrn. bridge.....	W. J. Arnold Co., Engrs., Topeka.
<b>MISCELLANEOUS</b>				
Florida.....	Lakeland.....	May 20, 3 p.m.....	Constrn. municipal building.....	Board Bond Trustees.
New York.....	Rochester.....	May 20, 11 a.m.....	Furn. 90 key-adding machine.....	T. J. Bridges, Chm. Bldg. Comm.
Minnesota.....	Lesueur Center.....	May 20, 10 a.m.....	Bldg. fireproof jail and residence.....	J. H. Kaisersall, County Aud.
Dist. Columbia.....	Washington.....	May 21.....	Furn. tandem steam road roller; also 10,000 ft. air hose.....	Navy Department.
California.....	Pasadena.....	May 21, 10 a.m.....	Constrn. incinerator.....	Herman Dyer, City Clk.
New York.....	Brooklyn.....	May 22, 11 a.m.....	Bldg. public comfort station.....	A. E. Steers, Boro. Pres.
Massachusetts.....	Roston.....	May 23, noon.....	Constrn. Section A, Dorchester tunnel.....	Boston Rapid Transit Comm.
Ohio.....	Cleveland.....	May 23, noon.....	Furn. 80 tons Trinidad asphalt cement.....	W. J. Springborn, Dir. Pub. Safety.
California.....	San Diego.....	May 27.....	Constrn. 800 ft. reinforced concrete pier.....	A. H. Wright, City Clk.
Ohio.....	Dayton.....	June 1, 10 a.m.....	Constrn. concrete retaining wall.....	J. O. Donovan, Sec'y Bd. Co. Comrs.
Indiana.....	Brazil.....	June 4.....	Constrn. court house, including heating plant.....	E. A. Staggs, County Aud.
Canada.....	Saskatoon, Sask.....	June 25.....	Furn. 70-ton incinerator.....	City Commissioners.
Texas.....	Dallas.....	July 15, 2 p.m.....	Constrn. city hall; cost, \$400,000.....	City Commissioners.

## STREET IMPROVEMENTS

**Montgomery, Ala.**—Sum of \$4,000 will be spent on one road in Butler County. Money has been appropriated by State. State Highway Department will have charge of survey and road building. The highway will be used as a model in central Alabama.

**Phoenix, Ariz.**—Council has approved plans to pave Second ave., from Jefferson to Monroe sts.; also for paving of Jefferson st.

**Lonoke, Ark.**—Sum of \$100,000 will probably be issued to construct pike from England to Lonoke.

**Oakland, Cal.**—Resolution has been adopted for improvement of various streets.

**Sacramento, Cal.**—Orders for preliminary surveys, plans and estimates for 328 miles of additional highways under \$18,000,000 bond issue has been issued by State Highway Commission to Highway Engineer A. B. Fletcher, thus completing orders for surveys on more than one-half of total mileage or road-way planned for construction on present bond issue. Surveys are now under way for 850 miles and orders will bring total to 1,178 miles. Total mileage proposed is 2,295.

**San Bernardino, Cal.**—Paving of F st., from Second to 10th st., has been ordered by City Council. Many miles of asphalt and macadam have been laid during the past three years at a cost of \$500,000.

**Meeker, Col.**—As result of co-operation of County Commissioners, citizens of Meeker and ranchers living along that section, Government road, 45 miles in length, between Meeker and Rifle, will be graded and placed in good condition.

**Newark, Del.**—Newark Council will spend \$12,000 on streets the coming summer.

**Jacksonville, Fla.**—At meeting of Board of County Commissioners third block of \$250,000 county road bonds was bid in by R. M. Grant & Co., of New York City.

**Tampa, Fla.**—Extensive street paving is recommended by bonding committee.

**Peoria, Ill.**—Paving of California, Brotherson and Peoria aves. is being considered.

**Pontiac, Ill.**—Board of Local Improvements is said to be planning to pave various streets.

**Indianapolis, Ind.**—Murray Construction Co., a new concern, was low bidder for resurfacing North Alabama st., from Massachusetts to Ft. Wayne aves. Company's bid for asphalt was \$3.55 a lin. ft. on each side of street and \$4,000 for street and alley intersections, and for wood block \$5.55 a lin. ft. on each side of street and \$6,100 for street and alley intersections.

**Indianapolis, Ind.**—Board has ordered city asphalt repair plant to repair paving in Meridian st., from 16th to 19th st., immediately.

**Portland, Ind.**—Meridian st., in Redkey, will be paved this summer, from Main st. north to corporation line, distance of more than a half mile.

**South Bend, Ind.**—Petitions have been filed for following improvements: Paving on first alley north of North Shore drive, between Michigan and Lafayette sts.; grade, curb and walk on 11th st., between Michigan ave. and Pleasant st.; also resolutions have been adopted by Board for following improvements: Grade, curb and walk on Kenyon st., between Portage ave. and west line of Morris's addition and on St. Vincent st., between Notre Dame and Eddy sts.

**Burlington, Ia.**—There is a movement on foot to have Main st. repaved with creosoted blocks.

**Des Moines, Ia.**—West Grand ave. will be widened from 14th to 15th sts.

**Des Moines, Ia.**—Resident owners on Woodland ave. have petitioned City Council to pave thoroughfare from 21st to 28th sts. with concrete. Petition has been referred to Street Superintendent Myerly.

**Sionx City, Ia.**—Resolutions which are expected to result in construction of about 26 blocks of cement sidewalks in various parts of city will be submitted to City Council.

**Cadiz, Ky.**—Issuance of \$150,000 road bonds is being considered.

**Flemingsburg, Ky.**—City will macadamize Garr ave.

**Lexington, Ky.**—Road Committee has advertised for bids for oiling sections of main thoroughfares of county. Contract will embrace from 90 to 100 miles of road upon which will be spread 100,000 gals. of oil.

**Winchester, Ky.**—Streets of Winchester have been torn up for connecting of sewers. As soon as this work is completed, preparations will be made for

paving of streets with brick, asphalt or other modern material.

**Portland, Me.**—Department of Public Works is about to improve following streets: Commercial st., head of Holyoke Wharf; West Commercial st., end of present paving to Portland Terminal Co. track; India st., between Middle and Congress sts.; Federal st., between Temple and Franklin sts.; Forest ave., between Jackson School and Cumberland ave.; Clark st., between Spring and Danforth sts.; Brighton ave., end of present paving to Nasons Corner; Veranda st., between Washington ave. and G. T. Ry. bridge; Pitt st. at old bridge site; Washington ave., between Gould and Veranda sts. Bion Bradbury, Jr., Commissioner of Public Works.

**Rockville, Md.**—County Commissioners are arranging to build new roads authorized by recent Legislature. Bonds in amount of \$47,000 will at once be issued for construction of roads from Rockville to Travilah, from Rockville to Potomac district line along Falls rd., from Georgetown pike to Kensington by way of Garrett Park and from Forest Glen to Brookeville pike. Work of construction will be started just as soon as preliminaries are completed.

**Saco, Md.**—Question of new and better pavement for Main st., Saco, is being discussed.

**Duluth, Minn.**—Petitions have been received for following: Grading Wicklow st., improving 21st ave. east, and paving Central ave.

**St. Paul, Minn.**—Resolution has been passed authorizing City Engineer to get six additional street sprinkling wagons.

**St. Paul, Minn.**—County Commissioners may take up petition for widening and improvement of White Bear and Lake Phalen rds. around south shore of White Bear Lake, to connect with Washington county line road to St. Paul, and with proposed road improvements east to complete circle of lake. This improvement along south shore is part of general plan for wide boulevard highway, to encircle White Bear Lake.

**St. Louis, Mo.**—Plaza on Grand ave., from Lindell to Forest Park blvds., has been planned by six members of City Plan Commission.

**Warrensburg, Mo.**—City has voted bonds for construction of about four miles paving.

**Bayonne, N. J.**—At meeting of Bayonne City Council ordinances calling for improvements of following streets were passed: Fourteenth st., from Boulevard to Ave. A; 41st st., from Broadway to Ave. C; 42d st., from Broadway to the Boulevard. Ordinances were introduced for improvement of 50th st., from Ave. B to Ave. C, and Fourth st., from Ave. A to Hobart ave.

**Bayonne, N. J.**—At meeting of Bayonne City Council ordinance calling for improvement of Ave. E, from Broadway to 52d st., was finally passed.

**Cranford, N. J.**—Township Committee has decided to improve several streets. Most important improvement will be that of north side of Union ave., between North ave. and Alden st. Engineer Mosher was instructed to prepare plans for sidewalk, curb and gutter grade.

**Elizabeth, N. J.**—County intends to improve North ave. west from business section to Aeolian works with amiesite.

**Elizabeth, N. J.**—Ordinances have been passed to pave Grove st., from Linden ave. to Murray st., with brick pavement on 6-in. concrete foundation; to order and cause curb on Westfield ave., from Morris ave. to Bayway, to be relaid and replaced where necessary, and to pave Louisa st., from Monroe ave. to Spring st., with trap block pavement on concrete foundation.

**Longport, N. J.**—Longport will hold special election on May 18 to vote on four bond issues. City proposes to issue \$6,000 worth of bonds for improvement of Atlantic ave.; \$14,000 for the sewerage system; \$2,000 for the electric light plant improvements and \$3,000 for beach front improvements.

**Lumberton, N. J.**—Lumberton Township Committee has decided to issue bonds to pay its share of cost of building shell road between Mount Holly and Lumberton.

**Morristown, N. J.**—Improvement of Western ave. has been discussed. Committee finally decided to pave between Ann and Plum sts. and beyond either of those as far as money would go.

**Newton, N. J.**—Freeholders' Committee has decided to go ahead and complete the construction of Stanhope-Newton macadam road.

**Paterson, N. J.**—County Engineer Ferguson has been instructed to furnish estimate of number of roads that are to be

oiled during coming summer and how much cost will be.

**Perth Amboy, N. J.**—It was practically decided to pave Water, Division and First sts. and one block on Lewis st. It is also intended to pave Division st., between New Brunswick ave. and Broad st.; First st., between Market and Lewis sts.; Lewis st., between First and Madison ave. Surface petitioned for was asphalt block, but under law, it is believed two or more surfaces must be advertised for.

**Wentworth, N. C.**—Chairman R. P. Richardson, of Good Roads Association, appeared before Board of County Commissioners and asked that election be called to give voters opportunity to pass on issuance of \$500,000 bond issue for construction of permanent roads in Rockingham County.

**Albany, N. Y.**—State Highway Commission has approved plans for letting of over 1,000 miles of improved highways in various parts of State. It is expected that contracts will be awarded early in June. The Commission has decided to build at this time about 30 miles of roads with new material, chiefly as an experiment. Monroe County, where several roads have been built of this material, favors its use.

**Amsterdam, N. Y.**—Common Council is discussing proposed extension of Carey st.

**Amsterdam, N. Y.**—City Clerk has been instructed to advertise for bids for paving river bridge with creosote treated wooden blocks.

**Kingston, N. Y.**—Ordinance has been passed for construction of sanitary sewer in portion of Washington ave. Roscoe Irwin is Mayor.

**Lockport, N. Y.**—Residents of LaGrange st., from Transit to Cottage, are petitioning for brick pavement. It is understood that system of paved streets in ward is planned. Harvey ave. and Saxton st. are to follow LaGrange with petitions. State will pave South Transit st.

**Niagara Falls, N. Y.**—City will shortly have municipal paving plant.

**Rochester, N. Y.**—Resolutions have been referred to Good Roads Committee, asking State Highway Commission to put on list of roads to be improved, the following: Canal rd. in Sweden, extending from western line of Brockport to county line, and from east line of Brockport to east line of Sweden; Scottsville-West Henrietta rd., extending from Brown's bridge over Genesee River to West Henrietta, distance of 2.85 miles; Lyell st. rd. in Ogden, from Union st. in Spencerport west to town line; North rd. in Wheatland, from Scottsville rd. to Brown's bridge, distance of 1.04 miles; Scottsville-East Rush rd. in Wheatland, extending from River rd. to Genesee River, distance of .7 mile; Scottsville-East Rush rd., from Genesee River east to connect with State-County rd., Honeoye Falls-East Rush at East Rush Village, distance of 4.55 miles; Fitch rd. in Wheatland, extending from Oak Creek rd. north to town line of Rigat, distance of 2.90 miles; Fitch rd., from south line of Rigat north to Rigat Center rd. and west from it to connect with Churchville-Rigat improved road, distance of 2.32 miles.

**Rome, N. Y.**—At meeting of Board of Public Works petition was read from several property owners for improvement of Elm st., between Jay and Madison sts. It was placed on file and the street added to list of streets to be paved. Petition was also read requesting that piece of road on town line, between Rome and Western, be extended about quarter mile. Matter was referred to Highway Committee for investigation.

**Schenectady, N. Y.**—Ordinance has been passed directing laying of sidewalks in Beaver st., from Lenox rd. to Van Vranken ave., where not already laid.

**Schenectady, N. Y.**—Commissioner of Public Works Charles A. Mullen has sent out requests to contractors for bids on resurfacing 5,000 sq. yds. of asphalt street pavement.

**Schenectady, N. Y.**—Through the efforts of Senator Loren H. White, two more Schenectady County roads will soon be improved. One road, from Esperance to Esperance station, 1.37 miles, will cost \$18,300, State paying \$11,895 and county and town of Duaneburgh \$6,405. Second road, from Quaker st. to Central bridge, costing \$48,900, will cost State \$31,785 and county and town of Duaneburgh \$17,115.

**Watkins, N. Y.**—Council is contemplating \$53,000 bond issue for paving purposes.

**Greensboro, N. C.**—Election will be held on July 23 for voting on \$130,000 bonds for improvement of streets, water mains and sewers.



**Wentworth, N. C.**—Rockingham County will vote June 4 on \$500,000 bond issue for road construction.

**Bismarck, N. Dak.**—Board of County Commissioners has voted to expend \$2,000 toward repairing Bismarck-Wilton rd. This is first step in movement to secure better roads for Burleigh County. Bids will be advertised as soon as specifications are prepared by County Surveyor.

**Cleveland, O.**—Oiling of large number of streets has been authorized. H. H. Canfield, Clerk.

**West Unity, O.**—Council of West Unity has sold to Stacey & Braun, of Toledo, a \$21,000 issue of 4% per cent. paving bonds at premium of \$236.25.

**Youngstown, O.**—Bids will be received until 2 p.m., May 20, at office of City Auditor, West Boardman st., for purchase of street improvement bonds. D. J. Jones, City Auditor.

**Ada, Okla.**—Sum of \$175,000 will probably be issued for road improvement.

**Eugene, Ore.**—At meeting of City Council Merrill, Oldham & Co., of Boston, Mass., were awarded recent issue of \$50,000 street paving bonds. Twenty-five other bids were submitted.

**Roseburg, Ore.**—N. Roseburg st. will be paved with concrete at cost of \$39,139.

**Erie, Pa.**—Resolution has been approved directing City Engineer to advertise for proposals for grading, curbing and paving French st., 16th to 18th sts.

**Erie, Pa.**—Ordinances have been passed for improving of various city streets.

**Harrisburg, Pa.**—Two petitions signed by more than 200 electors in South and West Hanover Townships requesting that road connecting Union Deposit and Manada Hill, be made part of State highway, have been presented to County Commissioners. Road is six miles long and is one of most popular in lower section of county. It connects two macadamized roads and in winter is almost impassable at times. Building of road will be very expensive.

**Lansford, Pa.**—Lansford Town Council will spend \$40,000 toward improving its streets.

**Lebanon, Pa.**—Highway Committee has been given full authority, at meeting of Select Council, to go ahead and spend \$6,000, appropriated to put city streets in good shape, as soon as it becomes available.

**McKees Rock, Pa.**—People will shortly vote on proposition of \$615,000 or more as bond issue for improvements to borough. If money is voted, Chartiers ave. and other streets will be paved.

**Tiverton, R. I.**—It has been voted to macadamize Canonicus st., plans and specifications to be ready for next meeting of Town Council.

**Chattanooga, Tenn.**—Bids will be received at Mayor's office until 10 a.m., May 22, for paving district bonds as follows: Bonds to amount of \$7,500.48 for Paving District No. 148, and bonds to amount of \$1,366.44 for Paving District No. 173. J. H. Warner, Mayor Pro Tem.

**Austin, Tex.**—Citizens have voted \$750,000 of bonds for improvements in city, of which \$250,000 will be for permanent street improvements.

**El Paso, Tex.**—Bliss st. and present Fort Bliss rd. will continue as official route to Fort Bliss, and will be paved at once.

**Fort Worth, Tex.**—Following the formal transfer of \$1,600,000 road and bridge bonds, County Commissioners have begun discussion of road construction with County Engineer Hayes. The Mansfield, Keller, Grapevine, Weatherford, Dallas and Azle rds. will be among first to receive attention of County Engineer.

**Fort Worth, Tex.**—Park Board has agreed to improve road through Hillside Park. City Commission will be asked to place Rosedale west from Eighth ave. under jurisdiction of Board to be graded, graveled and oiled as beginning for boulevard system outlined by City Expert Kessler.

**Franklin, Tex.**—Election will be held June 4 for voting of \$100,000 bond issue for improving county roads.

**Marshall, Tex.**—Council is considering bond issue for improving roads.

**Smithville, Tex.**—Bastrop County will shortly let contracts for construction of 60 miles of new roads. Two precincts have already voted for issuance of road bonds to amount of \$225,000 and another election will be held May 14 for purpose of issuing \$80,000 more of these bonds.

**Taylor, Tex.**—Special election has been held for voting bonds for paving certain streets and was easily carried. Main st. and several leading streets of town will be paved at once.

**Portsmouth, Va.**—Efforts will be made

by Seventh Ward Local Board of Improvement, to induce city to continue granite block pavement it intends to lay on Chestnut st., southwardly from South st. to Grace ave.

**Portsmouth, Va.**—Plans looking toward permanent improvement of upper High st., in Sixth Ward, have been mapped out by Local Improvement Board which will within next 10 days, ask for proposals for paving thoroughfare.

**South Richmond, Va.**—Councilman L. R. Brown has introduced resolution before Street Committee asking for appropriation of \$2,000 to complete work of improving Washington Park.

**Tacoma, Wash.**—Bond in sum of \$125,000 will be voted on for hard surfacing of roads in Point Defiance Park.

**Fulton, W. Va.**—Town of Fulton will start improvements on different streets of the town that are to be paved in near future. Fourth and Sixth sts. are to be paved with brick and other improvements made.

**New Cumberland, W. Va.**—Hancock County Court will construct about 10 miles of road in Grant district.

**Burlington, Wis.**—Lake Geneva, about 12 miles from this city, is contemplating number of improvements, which when completed will add greatly to status of town. New City Council has under advisement matter of street paving, and laying of sewers throughout city.

**Superior, Wis.**—Specifications and plans prepared by City Engineer's office for paving of Tower ave. have been passed and approved and Board of Public Works ordered to advertise for bids. Bids will be received on seven kinds of paving, asphalt, asphaltic concrete, sandstone blocks, bitulithic macadam, brick, concrete and creosoted blocks.

**Superior, Wis.**—Extension of permanent paving on Tower ave. as far north as First st. and excursion boat dock is being urged.

**Superior, Wis.**—It is likely that Tower ave. at intersection with North Third st. will be paved with plain macadam instead of permanent material to be put in on main thoroughfare of city as already proposed.

#### CONTRACTS AWARDED

**Fort Smith, Ark.**—For paving Garrison ave. with cement grouted vitrified block, between First and Second sts. and with creosoted wood block, from west side of Second st. to east side of 13th st., to Shelby & Bateman, of Little Rock, at about \$66,000.

**Phoenix, Ariz.**—To Barber Asphalt Paving Co., for paving portion of Jefferson st., between First and Second aves., at \$2.15 per sq. ft. for paving, 50 cts. per lin. ft. for cement curb, 75 cts. per lin. ft. for concrete pipe, \$47 for each manhole, \$25 for each catch basin.

**Los Angeles, Cal.**—To Fairchild-Gilmore-Wilton Co., of Los Angeles, at \$33,226, for paving vitrified block gutter, granite block gutter, sidewalk and culverts in Hill st.; also to C. H. Mattern, at \$10,867, for grading, graveling and constructing cement curb and gutter, granite block gutter and cement sidewalks in Sixth ave.

**Los Angeles, Cal.**—For building section of Sunset blvd., between Hollywood and its connection with Wilshire blvd., west of Beverly, by Board of Supervisors to P. A. & C. H. Howard. Their bid aggregated \$29,829, and distance is between four and five miles.

**Oakland, Cal.**—Bids for improvement of portion of grounds of County Infirmary have been opened by Board of Supervisors. Work to be done includes grading, curbing, guttering, draining and macadamizing. Estimate of County Surveyor on work was \$1,610, and following bids were submitted: E. B. & L. Stone Co., \$1,952; Robert P. King, \$1,649, and P. H. Hoare, \$1,602.05. Contract was awarded to P. H. Hoare, his bid being the lowest.

**South Pasadena, Cal.**—By City, for improvement of Mound ave., from Grevalia st. to Fair Oaks ave., to J. M. Montgomery, price to be \$1,321.11. D. C. Howard has secured contract to improve Oak st., from Wayne to Garfield. J. M. Montgomery was awarded contract for improvement of Hermosa st., from Rose ave. to Arroyo drive, cost to be \$4,208.70. Mr. Montgomery also has been awarded contract for improvement of Grevalia st., from Fair Oaks to Fremont, for \$1,567.55.

**Willimantic, Conn.**—To Charles Larrafee, Jr., for sidewalk construction, at 18 cts. per ft., and 16 cts. for resetting curb, by City.

**Augusta, Ga.**—By Streets and Drain Committee of City Council, three paving contracts. Total amount of contracts will be approximately \$60,000. Paving of

12th st. will be done by Georgia Engineering Co., and D. A. Bowe, as from Broad to D'Antignac will be paved with vitrified brick, and from D'Antignac st. to Milledgeville rd., with small Belgium blocks laid on concrete base. Price for brick is \$2.04 per sq. yd. and for Belgium blocks \$2.53. On Barrett Plaza and Telfair st., from Eighth to Ninth, there will be laid wooden blocks, by International Wood Block Paving Co., of New Orleans. Price for that work is \$2.85 per sq. yd.

**Aurora, Ill.**—For paving seven streets with asphalt, to McCarthy Improvement Co., of Davenport, Ia., for \$39,457.

**Bloomington, Ill.**—For paving with brick Woodland ave., to Ira D. Lain, of Bloomington, for \$10,280.

**Collinsville, Ill.**—For 13,850 sq. yds. brick paving, 7,400 lin. ft. combination granitoid curb and gutter in Paving District No. 3, to O. T. Dunlap, of Edwardsville, for \$30,018.

**Collinsville, Ill.**—To O. T. Dunlap, St. Louis ave., Collinsville, at \$35,018, for Paving District No. 3. Work includes 13,850 sq. yds. of vitrified brick on 4-in. concrete foundation, 7,400 ft. 2-ft. curb and gutter, 12 catch basins, six manholes, 370 ft. of 12-in. pipe, 6,201 ft. of 15-in. pipe, 577 ft. of 18-in. pipe and 1,280 ft. of 24-in. pipe.

**Jacksonville, Ill.**—By Board of Local Improvements, to John Cherry, 341 E. Main st., at \$7,143, for vitrified brick paving.

**Lincoln, Ill.**—By Board of Local Improvements, to Harvey K. Rhoads, of Lincoln, for paving Elm st.

**Peoria, Ill.**—By Board of Local Improvements, to A. D. Thompson, at \$33,410, for paving Knoxville ave.

**Rock Island, Ill.**—To McCarthy Improvement Co., for paving Second ave., at following bid: 4,644 ft. gutter flag, 45 cts.; 9,900 sq. ft. asphalt, \$1.99; 630 ft. 12-in. drain, 90 cts.; 960 ft. 10-in. drain, 60 cts.; 12 catch basins, each, \$30; 210 ft. 6-in. water pipe, \$1; also for paving Fourth ave., to Independent Construction Co., of Davenport, Ia., at \$14,352.

**Sycamore, Ill.**—By Board of Local Improvements, to George A. Peter, at \$17,750, for constructing 10,759 sq. yds. of brick pavement and 6,453 lin. ft. concrete curb and gutter.

**Anderson, Ind.**—By Board of Commissioners of Madison County, for construction of roads, as follows: Cal. Miller, W. H. Bingaman, A. D. Moffett, Frank Fath, Benj. L. Lee, Wm. O'Brien, W. H. Cavan and C. R. Bull rds., Madison Construction Co., \$3,990, \$1,060, \$1,100, \$750, \$800, \$875, \$800 and \$3,195, respectively; A. E. Summers rd., Mason & Moreland, \$1,827; A. S. Busby rd., Busby & Coy, \$5,873; Wm. C. Scott rd., Ryan & Son, \$7,450.

**Crawfordsville, Ind.**—For paving with brick two streets, to Geo. T. Miller, Lebanon, Ind., and Clements & Clements, Crawfordsville, at \$2,307.48 and \$10,695, respectively.

**Indianapolis, Ind.**—Bids have been opened by Board of Public Works for 6,000-gals. of fluxing asphaltum oil and three bids submitted were same. Bidders, the Standard Oil Co., Craig Oil Co. and the Indian Refining Co. each asked 4 1/4 cts. a gallon. Board decided to award contract to Standard Oil Co. Oil is to be used at city asphalt repair plant.

**Richmond, Ind.**—To Daniel G. Burkhardt, for construction of cement sidewalks on South E st., from 13th to 16th sts. on north side. Cost will be about \$1,700. A. F. Hooton was given contract for five-ft. sidewalks, curbs and gutters on both sides of Laurel st., from Sheridan to Northwest First st. Cost will be approximately \$1,285.

**Richmond, Ind.**—Contract for paving of North Seventh st., from Main to A, will be awarded either to Albert White, of Greenfield, or Philip Hipskind & Son of this city. Mr. White bid \$1.70 per sq. yd. for Metropolitan brick pavement, laid on base of 6-in. concrete, while Hipskind & Son bid \$1.50 for concrete, blocked off size of bricks. Board of Works favors brick pavement and will award contract to White, unless property owners petition for concrete. Cost of brick pavement will be about \$3,500.

**Clinton, Ia.**—By Board of Park Commissioners, to Thomas Carey & Son, at \$4,550, for construction of sidewalks, curbing and drain for River Front Park.

**Des Moines, Ia.**—By City, for paving E. 13th and Walker sts. with asphalt, about 8,423 sq. yds., to Des Moines Asphalt Paving Co., of Des Moines, at \$1.64 per sq. yd.

**Mason City, Ia.**—To George Gabler, Mason City, for street improvement, at \$1.08 per sq. yd. for paving and 35 cts. per lin. ft. for curbing.

**New Hampton, Ia.**—By City, for pav-

ing, to W. P. Garland & Co., of New Hampton, at \$1.14½ per sq. yd. for 10,000 sq. yds. paving and 19½ cts. per sq. ft. for 9,200 sq. ft. curb.

**Marion, Kan.**—To H. A. Rowland, of McPherson, by City Commissioners, to prepare plans for about 15,000 sq. yds. of paving.

**Lexington, Ky.**—By General Council, for construction of granite curb on Vine st., from Limestone to Merino st., to Carey-Reed Co., at \$1.10 per lineal ft.

**Lexington, Ky.**—To Carey-Reed Co., for improvement of South Limestone st., from Winslow st. to Virginia ave., by construction of roadway thereof, with asphalt paving, and by construction of concrete curb and gutter and resetting of old curb and for construction of storm water sewer pipe, manholes and catch basins thereon, at following prices: Sheet asphalt paving, per sq. yd., \$1.40; concrete, per cu. yd., \$4.50; resetting old limestone curb, per lin. ft., 15 cts.; concrete curb and gutter combined, per lin. ft., 55 cts.; resetting manhole tops to grade, each, \$2.50; cement paving in gutters, per sq. yd., \$1.25; brick paving in car tracks, per sq. yd., \$1.75; concrete in car tracks, per cu. yd., \$4.75; limestone headers, per lin. ft., 50 cts.; storm water sewer pipe, 24-in., per lin. ft., \$1.90; storm water sewer pipe, 18-in., per lin. ft., \$1; storm water sewer pipe, 12-in., per lin. ft., 75 cts.; manholes, each, \$30; catch basins, each, \$40.

**Louisville, Ky.**—To L. R. Figg Co., for paving with brick 10th and Eighth sts., at \$6,380.

**Gloucester, Mass.**—By Park Commissioners, for grading, grassing and completion of sections three and four of esplanade on Western ave., to Walter Cressy, at his bid of \$888.75, which is lowest. Only other figure was that submitted by Alden C. Brown, whose bid was \$992.50.

**Missoula, Mont.**—To George C. Dietrick & Co., Globe Bldg., Seattle, Wash., for first and second unit of \$100,000 paving job in Missoula.

**Jersey City, N. J.**—By Board of Freeholders, for paving westerly approach to Hackensack River bridge on Newark turnpike, to Contractor E. P. O'Neill, at \$5,730 for trap rock.

**Long Beach, N. J.**—To Miller Engineering & Construction Co., at \$36,949, for construction of gravel road in Long Beach.

**New Brunswick, N. J.**—By City, to Conrad Sebolt, for 16,000 sq. yds. on concrete paving, and T. H. Riddle, for 12,000 sq. yds. Topeka asphalt.

**Passaic, N. J.**—For improvement of Oak st., Chestnut st., Leonard pl. and Boulevard, with asphalt-macadam, to Union Building & Construction Co.

**Princeton, N. J.**—By Borough Council, for new sidewalk, to McCarthy & Sons Co., at \$490, and for curbing and guttering Moore st., to Reardon Co., at \$1,781.20.

**South Amboy, N. J.**—To Contractors J. F. Shanley & Sons, of Newark, for paving of Broadway.

**Buffalo, N. Y.**—By Common Council, for repaving Clinton and Hampshire sts., and Upper Terrace, with asphalt, to German Rock Asphalt & Concrete Co., D. S. Morgan Bldg., for \$48,570, and with brick, Kentucky and Vincennes sts., and Wood ave., to Benj. F. Spire, of Buffalo, for \$25,425.

**Lockport, N. Y.**—By special committee of five Aldermen, to Studebaker Co., of South Bend, Ind., to furnish this city at cost of about \$1,300 a street sprinkling and cleaning equipment to enable municipality to do its own street work hereafter.

**New York, N. Y.**—To Watson Construction Co., 2614 Aqueduct ave., New York City, at \$44,983, for regulating, grading, setting curb stones, flagging sidewalks, laying crosswalks, building approaches and erecting fences in Corlear ave., from 230th st. to 240th st.

**Rochester, N. Y.**—For paving McGee ave. with asphalt, to Whitmore, Rauber & Vicinus, 279 South ave., at \$10,219.

**Rochester, N. Y.**—For improvement of highways in Monroe County, by State Commission of Highways, as follows: Road 493 A, known as Pugsleys Hill, 48 mile, to Monroe Roads Co., Pittsford, for \$9,674.90; Road 574, known as the Fairport-Nine-Mile Point rd., 11.41 miles, to Julius Friedrich Co., Rochester, for \$199,159.25; Road 575, known as the Rush-Honeoye Falls rd., 4.08 miles, to Monroe Roads Co., Pittsford, for \$41,811.45; Road 588, known as the Monroe-Orleans County Line rd., 2.08 miles, to Harridine Brothers Co., Spencerport, for \$18,633.15; Road 633, known as the Walker-Lake Ontario rd., 3.75 miles, to Wood & Tompkins, Milton, for \$42,594.

**Syracuse, N. Y.**—To Warner-Quinlan

South Clinton st., from West Water st. to West Jefferson st., at \$6,460; for paving Otisco st., from South West st. to South Geddes st., with asphalt, to Guy B. Dickinson, at \$37,442.

**Syracuse, N. Y.**—By Board of Public Works, street sprinkling contracts, to Frank R. Paneltz in first, and C. T. Hookway Construction Co. in second and fourth, C. P. De Long in third and Wm. H. Kelley in fifth sprinkling district.

**Statesville, N. C.**—By City, to Kelly, Monroe & Meyer, Portsmouth, O., to pave sections of Broad and Center sts. with tarvia; paving in business section to be from curb to curb, and on three blocks of Center st. two 20-ft. driveways, with 20 ft. in center for parkway; cost, \$40,000.

**Chillicothe, O.**—By Commissioners of Rose County, for grading and paving with bituminated concrete Frankfort rd. in Scioto Township, to Ringwald & Sons, Chillicothe, at \$10,925. Length, 6,969 ft., or 1.31 miles. J. R. Marker, State Highway Commissioner.

**Cleveland, O.**—To Cleveland Trinidad Paving Co., Cleveland, at \$153,733, for improvement of Center Ridge rd. No. 2, in Dover Township. Bids were also received from following: M. E. Kavanaugh, \$153,499, concrete curb, and \$156,059, stone curb; Enterprise Paving & Construction Co., \$155,832, concrete curb, and \$155,192, stone curb.

**Eaton, O.**—By City Council, to Eubank & Fulkerson, New Madison, for oiling Barron and Somers sts., at their bid of 1-2-3 cts. per sq. yd. Other bidders were: Whitmore Oil Co., Dayton; E. C. Davis, Connersville, Ind.; W. E. Jones, New Paris, and S. J. Mann, Eaton.

**McArthur, O.**—To Jardine, Brewer & Tomlinson, Chillicothe, at \$22,389, for grading and constructing with water-bound macadam McArthur-Hamden rd., in Elk Township, Vinton County. James R. Marker, Columbus, is State Highway Commissioner.

**Jefferson, O.**—By Village Council, for paving as follows: Walnut, Ashtabula and Center sts., Geo. M. Harris & Co., Meadville, O., \$21,200, \$8,000 and \$2,600, respectively. Chestnut st., W. J. Kunkle Co., Ashtabula, O., \$40,000. Jefferson st., Dunkirk Construction Co., Dunkirk, N. Y., \$38,700.

**Logan, O.**—By Commissioners of Hocking County, for grading and paving with concrete section No. 1, Logan-Enterprise rd. in Falls Township, length 8,400 ft., or 1.59 miles, to Huston & Henderson, of Logan, at \$17,463.68.

**McArthur, O.**—To Jardine, Brewer & Tomlinson, Chillicothe, O., at \$22,389, for grading and construction of McArthur-Hamden rd. in Vinton County.

**Mt. Gilead, O.**—By Commissioners of Morrow County, for grading and constructing with waterbound macadam, having bituminous surface treatment, Cardington rd., Pet. No. 365, to J. M. Stone, Marion, O., at \$21,400. Length, 15,573.5 ft., or 2.95 miles. J. R. Marker, State Highway Commissioner.

**Steubenville, O.**—By Board of Control, for paving Maryland ave., to H. M. Bates, of Steubenville, for \$13,664.

**Urbana, O.**—By Commissioners of Champaign County, for grading and paving with waterbound macadam Urbana and St. Paris rd., to S. Monroe & Sons Co., Portsmouth, at \$8,893. Length, 5,280 ft., or 1 mile. J. R. Marker, State Highway Commissioner.

**Wilmington, O.**—By Commissioners of Clinton County, for grading and paving with waterbound macadam Wilmington-Xenia rd. in Union Township, length 20,750.4 ft., or 3.93 miles, to Weldon N. McKay, Bert Bloom and John A. Conner, at \$22,975.

**Youngstown, O.**—By Board of Good Roads Commissioners, on four roads to lowest bidder in each case. The contracts are as follows: Cornersburg rd., Kennedy Brothers, \$25,014.62; Boardman rd., Kennedy Brothers, \$11,362.30; Albert st. extension, James McCarron, \$9,660.67; Pleasant Grove rd., C. J. Chinnock, \$3,781.42.

**McMinnville, Ore.**—For paving 25 blocks in business district, to El Oso Asphalt Co., of Salem, at \$40,000.

**Salem, Ore.**—By City Council, for half a mile of Dolarway concrete pavement, to E. W. Geiger Contracting Co.

**Harrisburg, Pa.**—By State Highway Commissioner, for building road in Penn Township, Chester County, to W. F. Borneman & Co., at \$15,119.

**McKeesport, Pa.**—By City, to Bowman Brothers Co., for improving Fifth ave.

**Philadelphia, Pa.**—Awarding second asphalt repair contract to Eastern Paving Co., it was announced by Director Cooke that work of repaving Chestnut st. will begin shortly. The Eastern company obtained contract for repairs to non-trac-

tion streets, and also for traction street: Eastern company was lowest bidder, at 93 cts. per sq. yd. without renewal of foundations, and \$1.53 including renewal of foundations. Total amount of the awards to Eastern company is \$60,000.

**York, Pa.**—To build 6,200 running feet of State aid road in Fawn Township, extending from road in New Park to Maryland line, to Thomas Meehan & Sons, of Mt. Airy, at \$11,000.

**East Providence, R. I.**—By State Board of Public Roads, for macadamizing Pawtucket ave., to Jos. McCormick, of East Providence, at \$14,818.

**Woonsocket, R. I.**—By Aldermanic Committee on Street and Bridges, for oiling streets of city, to American Tar Sprinkling Co., of Worcester.

**Columbia, S. C.**—By City, to A. E. Legare Engineering Co., Columbia, to pave three blocks on East Gervais st. with brick.

**Knoxville, Tenn.**—By Monroe Road Commission, for grading 160 miles and constructing necessary concrete bridges for road system in Monroe County, to R. L. Peters, of Knoxville.

**Fort Worth, Tex.**—To Rudolph S. Blome Co., for paving East Third st. with granitoid, at \$2.06 a yd. Work will extend from Commerce st. to Denver Railroad.

**Victoria, Tex.**—By Victoria County Commissioners, to J. C. Kelso, Galveston, Tex., to construct gravel roads; \$200,000 bond issue has been authorized, which, it is estimated, will construct 60 to 75 miles of road.

**Norfolk, Va.**—To L. A. Tucker, for paving "A" ave., Ocean View. His bid was 65 cts. per sq. yd. for about 500 yds. high grade concrete, from First st. to Bay Shore right-of-way.

**Portsmouth, Va.**—By City, to F. J. McGuire, Norfolk, Va., at about \$50,000, for about 30,000 sq. yds. paving in Seventh Ward.

**Olympia, Wash.**—To McGuire Bros., Anacortes, Wash., at \$15,000, for hard surfacing of portion of State Aid Rd. No. 82, known as Fidalgo Bay State Aid Rd.

**Walla Walla, Wash.**—To John Hoffman, at \$7,714, for building John Seber rd.

**Oshkosh, Wis.**—To J. Rasmussen Co., Oshkosh, for construction of brick paving with sand filler on Wisconsin, DeWitt and Oneida sts., at \$1.48 per sq. yd. Other bidders were: E. R. Harding Co., Racine, Wis., \$1.49½, and E. L. Bartlett, Watertown, Wis., \$1.53.

**South Bend, Wash.**—For paving with bitulithic, to Barber Asphalt Paving Co., Northern Bank Bldg., Seattle, at \$15,657, and constructing retaining wall, to Jahn Contracting Co., at \$13,606.

#### BIDS RECEIVED

**Corona, Cal.**—For improving Eighth st.: John R. Ott, Merchants' Trust Bldg., Los Angeles, \$20,135; Highway Construction Co., \$21,755; J. J. Papac, \$21,870; W. J. Brand, \$22,819; Johnson-Shea, \$23,011; Louis Ferrill, \$23,709; Ford Contracting Co., \$33,899.

**Philadelphia, Pa.**—For repaving and repairing asphalt paved streets, as follows: (a) Resurfacing, per sq. yd.; (b) resurfacing, per sq. yd., when base is renewed; (c) for contingent work between street railway tracks: Eastern Paving Co., (a) 93 cts., (b) \$1.53, (c) 12 cts. to \$3.50; Filbert Paving & Construction Co., (a) \$1.19, (b) \$1.64, (c) 19 cts. to \$3.69; Barber Asphalt Paving Co., (a) \$1.30, (b) \$1.78, (c) 15 cts. to \$3.15. For repairs to non-traction streets: Eastern Paving Co., (a) 98 cts., (b) \$1.58; Filbert Co., \$1.19 and \$1.64, and Barber Co., (a) \$1.30 and \$1.78.

**Tacoma, Wash.**—For construction of eight miles of permanent highway: Troutman, Seattle, brick pavement on 4-in. concrete base with a 4-in. wearing surface, \$2.03 per sq. yd.; grading, \$7,560.60; total, \$154,280; maintenance for five years, \$5; total, \$161,846. Ferguson-Coit Co., Seattle, Dolarway pavement on 6-in. concrete base with 3-in. wearing surface, \$1.33 per sq. yd.; grading, \$6,243; total, \$101,080; maintenance, 2 cts. per sq. yd.; maintenance for five years, \$7,600; total, \$114,925. Joseph Water, Sr., Tacoma, Warrenite pavement on 4-in. concrete base with a 1½-in. wearing surface, \$1.63; grading, \$5,553; total, \$123,880; maintenance, 1 ct. per sq. yd.; maintenance for five years, \$3,800; total, \$133,233. Also Warrenite pavement on 5-in. concrete base with 1½-in. wearing surface, \$1.71 per sq. yd.; grading, \$5,553; total, \$129,960; maintenance, 1 ct. per sq. yd.; maintenance for five years, \$3,800; total, \$139,313; asphalt pavement on 4-in. concrete base with 1½-in. wearing surface, \$1.63 per sq. yd.; grading, \$5,553; total, \$123,880; maintenance, 1½ cts. per sq. yd.; maintenance for five years, \$5,700; total, \$135,133; concrete pavement on 4-in. concrete base with 2-in. wearing surface, \$1.30 per sq. yd.; grading, \$5,-